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FOREST RESOURCES OF THE WORLD

BY

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AND

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FOREST ECONOMISTS, FOREST SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE

With a Foreword by
GIFFORD PINCHOT

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CHAPTER IV

THE FOREST SITUATION IN NORTHERN NORTH AMERICA

CANADA

Forest Area.—The total land area of the Dominion of Canada is 2,386,985,600 acres. About one-fifth, 440,000,000 acres, has been estimated as agricultural land. Of this agricultural area a quarter is now classed as farm land and 43,500,000 acres was under field corps in 1917. One-fourth of the total land area, or about 600,000,000 acres, is estimated to be covered with forests. Of this, however, only 250,000,000 acres (390,625 square miles) is considered as containing saw timber of commercial size (above 10 inches in diameter on the stump). These figures are largely estimates, as vast areas of the Dominion have not yet been explored. Much of the timber on the land classed as forest land is inaccessible because of lack of economical transportation. Table 256 shows the area of merchantable forest (containing timber 10 inches and over in diameter), the area of unprofitable or inaccessible forest, and the percentage of land area covered by forest.

TABLE 256.—CLASSIFICATION OF LAND, CANADA

Character of land	Area	Per cent
	acres	
Agricultural	440,999,680	18.48
Forest:		
Merchantable	250,000,000	10.47
Unprofitable or inaccessible	346,746,240	14.53
Total	596,746,240	25.00
Other lands	1,349,239,680	56.52
Total	2,386,985,600	100.00

Other estimates place the area of saw timber of commercial value at about 170,000,000 acres. This does not include pulpwood, firewood, tie and pole material, or small material of any description.

Area per Capita.—The productive area of saw timber material is 34 acres per capita for the entire Dominion. If the entire area classed as forest land is considered, the per capita area will be about 82 acres. The forest area per capita of population varies, of course, in different provinces as may be gathered from the following table:

TABLE 257.—FOREST AREA AND POPULATION, CANADA

Province	Saw timber area	Population	Per capita area
	acres		*acres*
Prince Edward Island	.....	93,728	.....
Nova Scotia	5,744,000	492,338	12
New Brunswick	9,000,000	351,889	26
Quebec	100,000,000[1]	2,003,232	50
Ontario	70,000,000	2,523,274	28
Manitoba	1,920,000	455,614	4
Saskatchewan	3,584,000	492,432	7
Alberta	5,416,000	374,663	14
British Columbia	50,000,000	440,000	114
Yukon	.....	8,512	.....
Northwest Territories	.....	18,481	.....
Total	245,664,000	7,254,163	34

[1]According to the statement prepared for the British Empire Forestry Conference, the forest area is given as 203,490 sq. miles (130,233,600 acres), or 29.5 per cent of the land area.

The productive forest area is decreasing at the rate of about 3 or 4 million acres a year.

The Stand.—According to recent estimates made in 1921 by Roland D. Craig, of the Commission of Conservation in Canada, the total stand of both commercially accessible and inaccessible timber in Canada is 1,093,900 million board feet. Of this 892,900 million board feet, or 82 per cent, is softwoods, and 201,000 million, or 18 per cent, is hardwoods. Of the total stand a little more than half, or 564,000 million board feet, is sawlog material. Of the sawlog material 525,000 million board feet, or 93 per cent, is softwoods, and 39,000 million, or 7 per cent, is hardwoods. The small percentage of hardwoods of the total sawlog material is noteworthy. (Table 258.)

The pulpwood resources (spruce, balsam fir, jack pine, hemlock, and poplar) have also been estimated at 773,200 million board feet, or 1,546,380,000 cords. This includes some 270,860 million board feet,

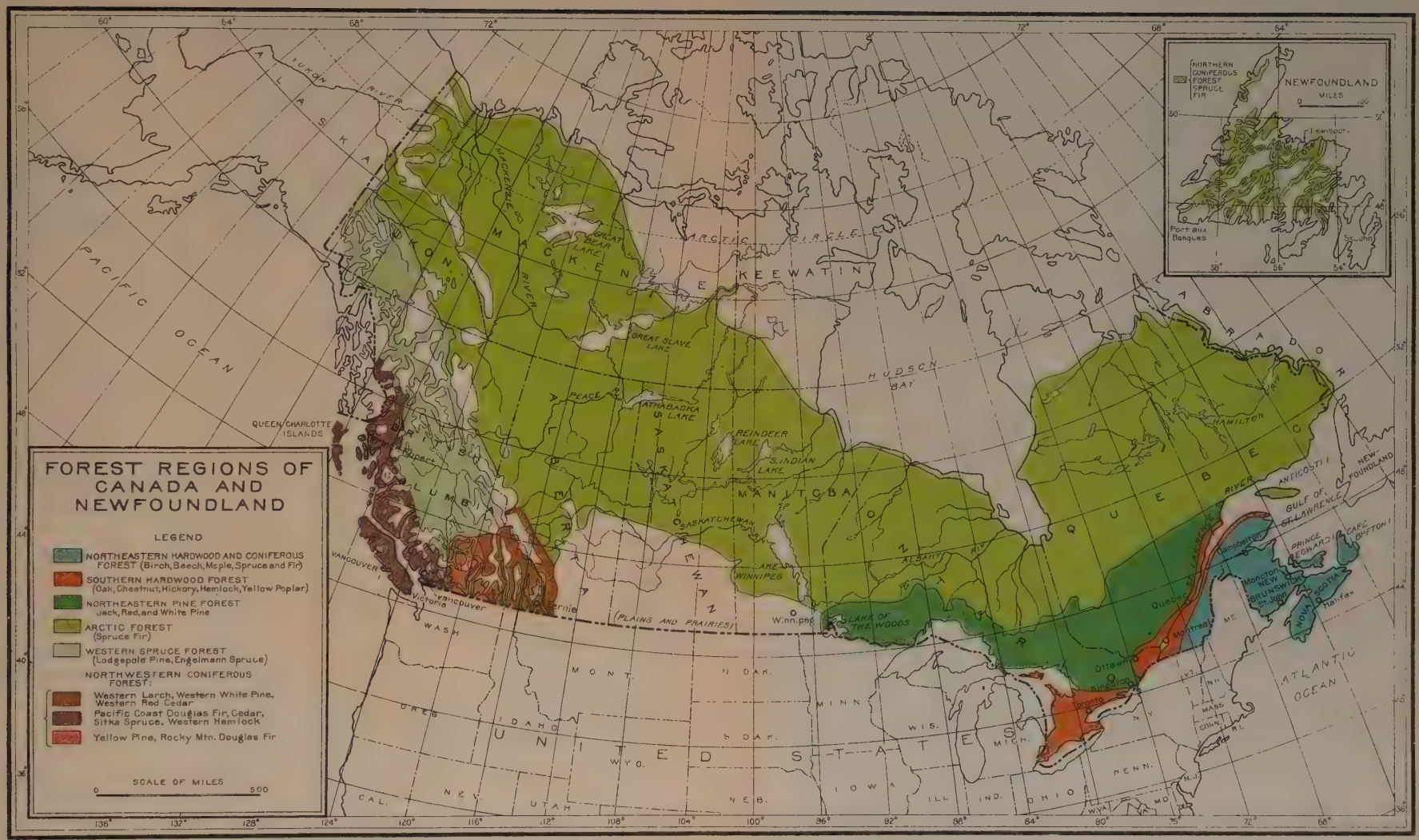
FOREST REGIONS OF CANADA AND NEWFOUNDLAND
LEGEND
NORTHEASTERN HARDWOOD AND CONIFEROUS FOREST (Birch, Beech, Maple, Spruce and Fir)
SOUTHERN HARDWOOD FOREST (Oak, Chestnut, Hickory, Hemlock, Yellow Poplar)
NORTHEASTERN PINE FOREST Jack, Red, and White Pine
ARCTIC FOREST (Spruce Fir)
WESTERN SPRUCE FOREST (Lodgepole Pine, Engelmann Spruce)
NORTHWESTERN CONIFEROUS FOREST:
Western Larch, Western White Pine, Western Red Cedar
Pacific Coast Douglas Fir, Cedar, Sitka Spruce, Western Hemlock
Yellow Pine, Rocky Mtn. Douglas Fir
SCALE OF MILES
0 500
NORTHERN CONIFEROUS FOREST SPRUCE FIR
NEWFOUNDLAND
MILES
Port aux Basques
St. John
ALASKA
YUKON RIVER
PACIFIC OCEAN
ARCTIC CIRCLE
MACKENZIE RIVER
GREAT BEAR LAKE
GREAT SLAVE LAKE
KEEWATIN
MACKENZIE
HUDSON BAY
LABRADOR
PEACE
ATHABASKA L. LAKE
REINDER LAKE
S. INDIAN LAKE
QUEEN CHARLOTTE ISLANDS
BRITISH COLUMBIA
MANITOBA
SASKATCHEWAN
ALBERTA
QUEBEC
HAMILTON
ANTICOSTI I.
NEWFOUNDLAND
GULF OF ST. LAWRENCE
RIVER ST. LAWRENCE
Campbellton
PRINCE EDWARD I.
CAPE BRETON I.
Moncton
NEW BRUNSWICK
St. John
NOVA SCOTIA
Halifax
Quebec
Montreal
Ottawa
Kingston
Toronto
Victoria
Vancouver
Vancouver I.
Prince Rupert
Fernie
(PLAINS AND PRAIRIES)
Winnipeg
LAKE WINNIPEG
LAKE OF THE WOODS
ATLANTIC OCEAN
UNITED STATES
WASH.
MONT.
N. DAK.
MINN.
OREG.
IDAHO
S. DAK.
WIS.
MICH.
WYO.
NEV.
UTAH
NEB.
IOWA
ILL.
IND.
OHIO
PENN.
N.Y.
VT.
N.H.
MASS.
CONN.
R.I.
N.J.
MD.
CAL.
136°
132°
128°
124°
120°
116°
112°
108°
104°
100°
96°
92°
88°
84°
80°
76°
72°
68°
64°
60°

PLATE X
FOREST REGIONS OF CANADA
AND NEWFOUNDLAND

(*Facing page 496*)

TABLE 258.—TOTAL STAND OF TIMBER IN CANADA

(In millions of board feet)

Species	Eastern provinces, Ontario, Quebec, New Brunswick, and Nova Scotia	Prairie provinces, Manitoba, Saskatchewan, and Alberta	British Columbia	Total, all Canada
White pine	56,000	.....	2,700	58,700
Red pine	6,000	.....	.....	6,000
Jack pine	35,200	77,800	11,800[1]	124,800
Western yellow pine	.....	.....	4,200	4,200
Hemlock	6,400	.....	70,000	76,400
Larch	200	3,500	3,150	6,850
Cedar	27,000	.....	82,100	109,100
Spruce	194,500	56,500	74,000	325,000
Balsam	61,000	3,500	34,800	99,300
Douglas fir	.....	500	78,000	78,500
Yellow cypress	.....	.....	4,050	4,050
Total, softwoods	386,300	141,800	364,800	892,900
Maple	16,500	.....	.....	16,500
Yellow birch	25,000	.....	.....	25,000
White birch	12,300	11,500	.....	23,800
Ash	3,600	.....	.....	3,600
Elm	1,550	.....	.....	1,550
Oak	1,400	.....	.....	1,400
Beech	6,950	.....	.....	6,950
Basswood	4,000	.....	.....	4,000
Poplar	42,400	74,000	1,000	117,400
Cottonwood	.....	.....	750	750
Miscellaneous hardwoods	.....	.....	50	50
Total, hardwoods	113,700	85,500	1,800	201,000
Total stand	500,000	227,300	366,600	1,093,900

[1]Lodgepole pine.

or 541,700,000 cords of saw material, and 502,340 million board feet, or 1,004,680,000 cords of pulpwood. Not all of the pulpwood is commercially accessible under the present regulations, standards, markets, and transportation conditions. Only 558,000,000 cords, or about one-third of the total pulpwood resources, may be considered accessible, as follows:

	Cords
Spruce, balsam, and western hemlock	480,000,000
Lodgepole pine, jack pine, eastern hemlock, poplar, and cottonwood	78,000,000
	558,000,000

In a general way, therefore, it may be stated that there is about 1,000 billion board feet of standing timber in Canada. Half of this might be suitable for the manufacture of lumber and three-fourths for pulp, but only half is commercially accessible at the present time.

These estimates are higher than some previously given. Thus, in the report of the Forestry Branch of the Department of Interior of Canada for 1920, the stand of merchantable saw timber was estimated at about 62½ billion cubic feet and that of pulpwood at 81 billion cubic feet, in all 143½ billion cubic feet, or about 700 billion board feet.

Using Craig's figures, the forest area and the stand have been estimated to be distributed by provinces as shown in Table 259.

TABLE 259.—DISTRIBUTION OF FOREST AREA AND STAND

Provinces	Land area	Sawtimber area	Ratio of forest to land area	Total stand of timber (in millions)			
				Soft-woods	Hard-woods	Total	
	acres	*acres*	*per cent*	*board ft.*	*board ft.*	*board ft.*	*cu. ft.*[1]
British Columbia	226,186,240	50,000,000	22	364,800	1,800	366,600	76,253
Alberta	161,000,000	5,416,000	3	58,500	41,500	100,000	20,800
Saskatchewan	155,764,080	3,584,000	2	56,300	26,500	82,800	17,222
Manitoba	148,432,640	1,920,000	1	27,000	17,500	44,500	9,256
Ontario	234,163,200	70,000,000 to 90,000,000	30 to 38	162,550	23,000	185,550	38,594
Quebec	442,153,600	100,000,000	23	187,075	65,000	252,075	52,432[2]
New Brunswick	17,863,040	9,000,000	50	21,500	10,600	32,100	6,677
Nova Scotia	13,483,500	5,744,000	43	15,175	15,100	30,275	6,297
Total	1,399,046,300	245,664,000 or 265,664,000	18 or 19	892,900	201,000	1,093,900	227,531

[1] 208 cubic feet assumed to equal 1,000 board feet of standing timber.

[2] According to "Forestry in the Province of Quebec" (Statement prepared for the British Empire Forestry Conference, 1920) the forest wealth is 38,750,000 cubic feet, distributed among the different species as follows:

Species	*Stand*
White and red pine	3,750,000,000 cu. ft.
Spruce, balsam, hemlock and other coniferous species, except cedar	15,625,000,000 cu. ft.
Cedar (Arborvitae)	2,500,000,000 cu. ft.
Pulpwood	12,500,000,000 cu. ft.
Hardwoods	4,375,000,000 cu. ft.
Total	38,750,000,000 cu. ft.

This estimate includes only merchantable timber and omits the young growth. From the standpoint of the pulp and paper industry, that is, considering on all accessible forest lands, either privately owned, leased, or unleased, the trees such as spruce, balsam, poplar, and aspen of 4 in. in diameter and over, which can be manufactured into pulp and paper, the Quebec forests, according to G. C. Piche's estimate, would contain 360,000,000 cords. Of this quantity about 155,000,000 cords would be really available.

One-third of the total stand of timber is thus credited to British Columbia. It is seriously doubted, however, if British Columbia has such a large stand of merchantable saw timber. A. L. Clark of the Vancouver Lumber Company estimates the resources of British Columbia at approximately 150 billion board feet. Dr. Judson Clark, the well-known authority on timber in British Columbia, estimates the total stand of merchantable timber accessible to the logger to be only 100 billion board feet. According to these estimates there remains now in British Columbia only about 25.5 million acres of commercial forest land. Even of this only 50 per cent, it is claimed, can be seriously considered as containing accessible, loggable timber, the rest being on rocky, steep ground where the cost of logging and the breakage would be so great that it would not tempt a logger to operate for many years to come.

Character of Forest.—Although the total land area of the Dominion of Canada is larger than that of the United States, it is comparatively poorly timbered. Valuable timber is unevenly distributed over a large territory, and the composition of the forests is extremely simple and of few species. While Canada is a country of endless woods, really good timber is limited. The country may be divided into a number of forest regions.

1. *Mixed Forest of Birch, Maple, Beech, and Conifers.* This is found in the maritime provinces, together with the eastern townships of Quebec south of the St. Lawrence River. This type of forest is similar to that of the northeastern United States. White pine having been largely removed, red spruce and hemlock are now the prominent timber trees, with balsam fir as a frequent concomitant. Black spruce and white cedar occur in swamps, while white spruce is rare in the forest but prominent in the reforesting pastures.

2. *Southern Hardwood Forest (Oak-Hickory).* This comprises some of the more southern hardwood species, such as elm, oak, hickory, walnut, yellow poplar, chestnut, and even such southern species as sycamore, coffee tree, honey locust, and sassafras. Spruce and balsam fir are usually absent, and pine and hemlock occur only sparsely but are of fine development. This type is not unlike the hardwood type of Indiana and Ohio and the northern fringe of the Southern Appalachians. It is confined to the glacial deposits of the St. Lawrence Valley.

3. *Northern Pine-Hardwood Forest.* This type is confined to the Laurentian plateau, a country of lakes and swamps, alternating with low hills and plateaus. It is a mixed hardwood and coniferous forest of red oak, yellow birch, ash, maple, elm, basswood, aspen, balsam fir, white spruce, and particularly white pine, red pine, and hemlock.

This type is similar in character to that of the Great Lakes region of the United States. A century of logging has removed the accessible pine almost entirely and the main timber tree is now hemlock, which is being cut in ever-increasing amounts.

4. *The Northern or Sub-arctic Coniferous Forest (Spruce and Fir).* This is located north of the Height of Land on the northern slope of the Laurentian plateau, and is scattered over a vast territory of 960 million acres. It has been only superficially explored and explorations have mostly followed the river courses. Although this forest may be of utmost value for home use by the prospective settler and miner, it is of no commercial value to eastern civilization, especially as the direction of down grades is away from markets. It continues northwestward into Alaska to within a short distance of the Behring Sea and Arctic Ocean.

5. *Lodgepole Pine Forest.* This type is confined to the northern Rocky Mountains. The region is little known except that it is a dry section with an open growth of lodgepole pine of low commercial value.

6. *Western Larch and Western White Pine Forest.* In Canada, this type is confined to the Rocky Mountains of Southern British Columbia. It includes yellow pine, silver fir, Engelmann spruce, and western larch, the representative timber trees, with Douglas fir, cedar, hemlock, and lodgepole pine in minor occurrence, to which eastern white spruce may be added. This type, varying somewhat in composition and development, extends to nearly the 53rd degree of latitude.

7. *Douglas Fir or Southern Pacific Coast Forest.* This is a belt of forest west of the Coast Range running for 200 miles north and rarely broader than 50 miles at most from the shore, except at the southern boundary, where it reaches 150 miles inland and crosses the Canadian Pacific Railroad a few miles east of Yale. The large island of Vancouver is included in the belt. Among the main timber trees are Douglas fir of magnificent development, hemlock, and giant red cedar.

8. *Sitka Spruce and Western Hemlock Forest.* This is confined to the shores of the islands on the northern Pacific coast, and extends all the way along the Alaskan shore to Cooks Inlet. It is made up mainly of western hemlock, Sitka spruce, and yellow cedar.

Important Timber Trees of Canada.—There are over 130 species of tree size representing over 40 genera. Of these, only about 60 or 70 are sawn into lumber. The following species together furnish over 95 per cent of the lumber sawn and practically all of the pulp wood, poles, ties, and other forest products of Canada. Canada's forest resources are essentially of a coniferous nature; hardwoods form only about 3 per cent of the total quantity of lumber produced.

The following are the principal commercial trees of Canada:

Five species of spruce:
- White spruce (*Picea canadensis*).
- Sitka spruce (*Picea sitchensis*).
- Red spruce (*Picea rubra*).
- Engelmann spruce (*Picea engelmanni*).
- Black spruce (*Picea mariana*).

Two species of white pine:
- Eastern white pine (*Pinus strobus*).
- Western white pine (*Pinus monticola*).

Douglas fir (*Pseudotsuga taxifolia*).

Two species of hemlock:
- Eastern hemlock (*Tsuga canadensis*).
- Western hemlock (*Tsuga heterophylla*), far superior to eastern hemlock as a timber tree, and often called Alaskan pine to avoid confusion with the eastern species.

Two species of cedar:
- Western red cedar, or giant arborvitae (*Thuya plicata*).
- Eastern cedar (*Thuya occidentalis*).

Red pine (*Pinus resinosa*).

Four species of balsam fir of commercial importance, the eastern species (*Abies balsamea*) being the most important.

Western yellow pine (*Pinus ponderosa*).

Two larches:
- Eastern tamarack (*Larix laricina*).
- Western larch (*Larix occidentalis*).

Two birches:
- Yellow birch (*Betula lutea*).
- Paper birch (*Betula alba var. papyrifera*).

The following species are largely of local importance, although some of them are exported:

Four species of maple:
- Sugar maple (*Acer saccharum*).
- Silver maple (*Acer saccharinum*).
- Red maple (*Acer rubrum*).
- Broad-leaved maple (*Acer macrophyllum*).

Jack pine (*Pinus banksiana*).

Lodgepole pine (*Pinus contorta*).

Beech (*Fagus grandifolia*).

Two elms:
- Rock elm (*Ulmus racemosa*).
- White elm (*Ulmus americana*).

Basswood (*Tilia americana*).

Three species of poplar:

Aspen (*Populus tremuloides*).

Balm (*Populus balsamifera*).

Western cottonwood (*Populus trichocarpa*), which is a valuable timber tree in southwestern British Columbia.

White ash (*Fraxinus americana*).

There are twelve oak species in Canada. Of these the most important are white oak (*Quercus alba*) and red oak (*Quercus rubra*), the supply of which is almost exhausted.

Yellow cypress (*Chamaecyparis nootkatensis*).

A few valuable cabinet woods are found in small quantities in southwestern Ontario. They are chestnut (*Castanea dentata*), hickory (*Hicoria cordiformis, H. alba, H. glabra, and H. ovata*), butternut (*Juglans cinerea*), black walnut (*Juglans nigra*), cherry (*Prunus serotina*), yellow poplar (*Liriodendron tulipifera*), and others.

Character of Ownership.—Of the total forest area, 93.3 per cent belongs to the state and 6.7 per cent to corporate bodies and private timber owners. This 93 per cent of state forests includes 25 per cent of forest set aside for timber production and 68 per cent of other forest land. Private ownership is not classified according to productive timber areas and other forest land. Town and communal forests, so common in Europe, are almost unknown in Canada.

The state, or crown lands, including timber lands, are in most cases administered by the provinces in which they are located. In the three prairie provinces, Manitoba, Saskatchewan, and Alberta, in the so-called railway belt, a strip 20 miles wide on each side of the Canadian Pacific Railway's main line through British Columbia, and in the Peace River block in northern British Columbia, the crown lands are administered by the Dominion government. In this area there are few privately owned timberlands other than farmers' woodlots. Rights to cut timber are granted, but the title to the land remains in the crown. In Nova Scotia the greater part of the timber has passed into private ownership. In New Brunswick over 4,480,000 acres of forests are owned outright by railway companies and other private concerns or individuals. In Quebec about 6 million acres have been disposed of to private owners, and in Ontario about 5 million acres. In British Columbia the government has retained title to 87 per cent of the timberlands.

Corporate bodies (railroad companies) and private individuals in British Columbia own 12,352,000 acres of timberland, while the state has title to 83,008,000 acres, both temporarily alienated and unalienated. This includes saw-timber land as well as other forest land. The ownership of timberland, however, does not give a true picture of the ownership of saw-timber in the province of British Columbia. Thus, while

the crown actually owns 7½ billion cubic feet of mature saw-timber, or 26 per cent, private interests under licenses, leases, timber sale contracts, or outright crown grants, own 21,750,000,000 cubic feet, or 74 per cent of the total stand of mature timber in the province. In addition, there is an estimated total of about 1,250,000,000 cubic feet of piling, poles, and pulpwood, which is probably owned in similar proportions.

It is now practically a fixed policy in the Dominion of Canada not to dispose of public lands fit for the production of timber. The classification of forest area by ownership and the areas on which the

TABLE 260.—OWNERSHIP OF FORESTS, AND DISTRIBUTION OF GOVERNMENT TIMBER RESERVES

Item	Area belonging to—				Total
	The state			Corporate bodies and private individuals	
	Dedicated to timber production	Other forest	Total		
Acres	149,978,240	406,768,000	556,746,240	40,000,000	596,746,240
Percentage of total forest area	25.14	68.16	93.3	6.7	100.00

GOVERNMENT TIMBER RESERVES

	Acres
British Columbia—	
Provincial reserves	57,600
Dominion reserves	1,740,339
Dominion parks	657,920
Total	2,455,859
Alberta—	
Dominion reserves	12,438,080
Dominion parks	4,316,000
Total	16,754,080
Saskatchewan—	
Dominion reserves	5,953,728
Manitoba—	
Dominion reserves	2,386,675
Ontario—	
Provincial reserves	14,430,720
Quebec—	
Provincial reserves	107,997,440
Total of Dominion reserves	22,518,822
Total of Dominion parks	4,973,920
Total of provincial reserves	122,485,760
Grand total of area dedicated to timber production	149,978,502

government owns both timber and land are given in Table 260 by provinces.

Annual Growth.—No figures of growth are available for the forests of Canada as a whole. There are a few growth measurements within small restricted areas, but these are not sufficient to provide a basis for a rough estimate for the Dominion. Thus for British Columbia it has been calculated that growth is now taking place on over 62,000,000 acres of forest land. The total gross growth in the province of British Columbia has been estimated at 796,500,000 cubic feet, the annual loss by fire at 25,000,000 cubic feet, and the loss through waste and decay at 277,333,000 cubic feet, or a total loss of 302,333,000 cubic feet a year. This leaves a net growth for the province of some 494,167,000 cubic feet, or about 2½ billion board feet, which nearly equals the present annual cut in British Columbia. In the moist mild climate of the Pacific Coast region the average rate of growth is about twice the average for the rest of Canada. Since the eastern provinces have been logged off for a longer time than British Columbia, the cut-over area, and therefore the growing area, is probably much larger than in British Columbia. Allowing that the growing area of the eastern provinces is even four times as large as that of British Columbia and disregarding the difference in growth due to the more favorable climate of the Pacific coast, the total annual net growth on the forests of the Dominion of Canada can not be greater than 2½, or more likely, 2 billion cubic feet. This figure would also be indicated by a comparison with the forests of the United States.[1]

Annual Cut.—The total annual cut of all classes of forest products has been estimated at 2½ billion cubic feet. This estimate, however, is not based on direct measurements. Accurate figures are available only for the cut of saw timber and pulpwood. The average annual cut of saw timber for the period between 1910 and 1914, inclusive, is given as 898,769,457 cubic feet, or about 4½ billion board feet. The average yearly cut of pulpwood during the same period was 208,118,542 cubic feet, or a total of 1,106,888,000 cubic feet. The cut of all classes of forest products, then, amounts to 10 cubic feet per acre for an area of 250,000,000 acres. For the saw timber and pulpwood alone it amounts to only 4 cubic feet per acre per annum, a rather small cut.

Loss from Fire and Other Agencies.—There are no complete figures as to the loss from fire. On the basis of figures available for certain

[1]The total gross growth for Quebec has been estimated at 658,469,440 cubic feet, the annual loss by fire at 17,440,000 cubic feet, and the loss through waste and decay at 243,750,000 cubic feet, or a total loss of 261,190,000 cubic feet a year. This leaves a net growth of 397,279,440 cubic feet.

"Forestry in the Province of Quebec." Statement prepared for the British Empire Forestry Conference, London, 1920.

provinces, however, it has been estimated that the total loss from fire or other causes might possibly reach 2,500,000,000 cubic feet per annum. This, together with the total cut of 2½ billion, would represent a drain upon the forests of Canada amounting to 5 billion cubic feet. When the drain upon the forests is compared with the estimated increment of 2 or 2½ billion cubic feet, it would seem that depletion is from two to two and one-half times greater than growth.

Exports and Imports.—The average annual exports from Canada for the period between 1910 to 1919, inclusive, of saw timber and pulpwood amounted to 459,622,739 cubic feet (in the form of standing timber), or nearly one-third of the entire annual cut. Of this, 356,689,402 cubic feet, or some 1,785,000,000 board feet, was sawn lumber and 102,933,337 cubic feet pulpwood. To this must be added the export of pulp, which represented on the average for 1915–20 an equivalent of 81,000,000 cubic feet. The total exports amount, therefore, to 540,622,739 cubic feet.

The average annual imports during the same period were 99,070,912 cubic feet or 495,500,000 board feet, all sawn lumber; no pulpwood was imported. The excess of exports over imports was thus 441,551,827 cubic feet, of which 257,618,490 cubic feet (1,290,000,000 board feet)

TABLE 261.—DISTRIBUTION OF CANADIAN EXPORTS BY COUNTRIES
(For the Fiscal Year Ending March 31, 1920)

Country	Total	Per cent	Wood unmanufactured and round timber	Lumber and timber, hewn and sawn
	M bd. ft.		*M. bd. ft.*	*M. bd. ft.*
United States	2,285,922	72.6	574,971	1,710,951
United Kingdom	760,927	24.2	31,538	729,389
South America	26,427	0.8	.....	26,427
China	21,111	0.7	96	21,015
West Indies and Bermuda	17,737	0.6	1	17,736
Australia and New Zealand	10,765	0.3	2	10,763
Africa	10,276	0.3	.....	10,276
Japan	6,687	0.2	443	6,244
Newfoundland	4,093	0.1	183	3,910
Europe	1,796	0.1	42	1,754
Philippines	978	.....	4	974
Mexico	390	.....	.....	390
Others	2,375	0.1	.....	2,375
Total	3,149,484	100.0	607,280	2,542,204

was sawn lumber. The value of exports f. o. b. amounted to $37,177,971, while the value of imports c. i. f. was $10,603,615—a balance in favor of Canada of some $26,574,356.

Distribution of Export by Countries.—The distribution of Canadian exports by countries is given in Table 261.

Nearly three-fourths (72 per cent) of all the exports of lumber and round timber (including pulpwood) is shipped to the United States. If to this be added pulp and newsprint paper, the percentage of exports of forest products from Canada to the United States is very large indeed. Of certain products as, for instance, pulpwood, 100 per cent of the exports were shipped to the United States. Next in importance as a customer of Canadian forest products is the United Kingdom. The remaining countries take only a small part of Canada's exports. The different timber regions of Canada, however, participate differently in the export of forest products. Eastern Canada ships most of its products to the United States. There are no figures for the distribution of shipments by rail from British Columbia. The prairie markets of Canada absorb most of these shipments. Small amounts reach eastern Canada and some is shipped to the United States. The water-borne export from British Columbia is shown in Table 262. The greatest amount of timber from British Columbia is shipped by water to the United Kingdom and Europe; the next in amount goes to Australia.

TABLE 262.—WATER-BORNE EXPORTS FROM BRITISH COLUMBIA FOR THE YEARS 1919–1920

Country of destination	1919	1920
	bd. ft.	*bd. ft.*
Australia	8,515,600	32,218,155
New Zealand	.....	4,159,099
South America	1,551,574	5,523,102
China	17,183,430	14,911,232
Japan	4,675,730	5,990,266
United Kingdom and Europe	65,384,100	61,217,805
South Africa	5,044,672	7,330,531
India	.....	5,385,268
United States	5,259,346	4,162,845
Philippine Islands	785,726	2,996,123
Straits Settlements	475,088	234,479
Mexico	.....	1,015,414
Cuba and other West Indies	.....	1,479,950
Total	108,875,266	146,624,269

China, Japan, South Africa, and India absorb considerable quantities of British Columbia exports. Since the economic ties between Canada and the United States are very close, it is of interest to compare the kind of timber imported into Canada from the United States and that exported to the United States from Canada. Table 263 shows the exchange of timber products between Canada and the United States.

It is of interest to know that Canada imports chiefly hardwoods from the United States—oak, walnut, ash—and some of the Central and South American hardwoods, such as mahogany, rosewood, sandalwood, and

TABLE 263.—TRADE IN LUMBER AND TIMBER BETWEEN CANADA AND UNITED STATES (YEAR ENDED DECEMBER 31, 1920)

Kind of product	Quantity	Value
Imports into Canada from United States:		
Lumber and timber, hewn or sawn:		
Lumber and timber, planks and boards, when not otherwise manufactured than rough sawn or split or creosoted, vulcanized, or treated by any other preserving process:		
African teak, amaranth, black heart, ebony, boxwood, cocobola, dogwood, lignum vitae, persimmon, red cedar, and satin wood	.....	$ 58,412
Cherry, chestnut, and hickory (M bd. ft.)	12,631	1,346,141
Gum (M bd. ft.)	13,071	1,130,161
Mahogany (bd. ft.)	2,448,302	615,793
Oak (M bd. ft.)	43,044	5,206,238
Pitch pine (M bd. ft.)	33,318	1,660,432
Redwood (bd. ft.)	258,883	19,169
Rosewood (bd. ft.)	9,055	3,747
Spanish cedar (bd. ft.)	66,047	14,327
Sycamore (bd. ft.)	75,658	7,434
Walnut (bd. ft.)	2,138,364	370,188
White ash (bd. ft.)	647,555	121,801
Whitewood or yellow poplar (M bd. ft.)	5,095	622,933
Lumber and timber, not otherwise provided:		
Lath (M)	8,355	80,258
Lumber, rough sawn, or dressed on one side (M bd. ft.)	52,546	3,336,595
Pickets	.....	2,755
Sawn boards, planks, deals, planed or dressed on one or both sides, when the edges thereof are jointed or tongued and grooved (M bd. ft.)	2,288	191,398
Shingles (M)	8,325	30,552
Timber, hewn or sawn, squared or sided or creosoted, etc.	.....	150,435
Total lumber and timber imports	.....	$14,968,769

TABLE 263.—TRADE IN LUMBER AND TIMBER BETWEEN CANADA AND UNITED STATES —*Continued*

(YEAR ENDED DECEMBER 31, 1920)

Kind of product	Quantity	Value
Exports from Canada to United States:		
Lumber and timber:		
Lath (M)	431,993	$ 3,982,740
Pickets (M)	45,616	514,322
Planks and boards:		
Pine (M bd. ft)	425,067	19,247,426
Spruce (M bd. ft.)	601,184	23,219,804
Other (M. bd. ft.)	280,255	12,252,000
Shingles (M)	1,936,505	11,249,942
Shooks	.....	177,051
Staves and headings	.....	127,036
Timber, square:		
Douglas fir (M bd. ft.)	2,551	72,106
Hardwood (M bd. ft.)	422	23,253
White pine (M bd. ft.)	67	3,301
Other, n.o.p. (M bd. ft.)	1,591	48,679
All other lumber, n.o.p	.....	72,315
Total lumber and timber exports	.....	$70,989,975

Spanish cedar. The imports of softwood timber are almost negligible. On the other hand, Canada exports to the United States either softwood timber like spruce or softwood forest products such as shingles, lath, and so on. The exports of hardwood are negligible.

The exports of lumber and lumber products to the United States show a slight increase since 1912, while the imports from the United States decreased from 1912 to 1919. This is clearly brought out in Table 264, and shows the relative economic position of the two countries as regards the available timber resources.

Domestic Consumption.—With a total cut of sawtimber and pulpwood amounting to 1,106,887,999 cubic feet, of which 459,622,739 cubic feet are exported in the form of sawn lumber and pulpwood and 81,000,000 cubic feet in the form of pulp, there remains a home consumption of home-grown timber of 566,265,260 cubic feet. To this, however, must be added 99,070,912 cubic feet of imports of sawn timber, which brings the total home consumption of home and imported timber up to 665,336,172 cubic feet, or 92 cubic feet of saw timber and pulpwood (375 board feet of sawn lumber and 14 cubic feet of pulpwood) per head of population. If, however, to this be added an estimated cut of 1,393,100,000 cubic feet of other forest products in the Dominion, the total per capita consumption rises to the large figure of nearly 285 cubic feet.

TABLE 264.—EXCHANGE OF LUMBER AND LUMBER PRODUCTS BETWEEN THE UNITED STATES AND CANADA (INCLUDING TIES)

Year	From United States		Per cent to Canada
	To Canada	To all countries	
	bd. ft.	*bd. ft.*	
1912	685,293,000	2,435,641,000	28.1
1913	789,153,000	2,837,136,000	27.8
1914	627,019,000	2,612,403,000	24.0
1915	275,106,000	1,254,503,000	21.9
1916	214,756,000	1,325,921,000	16.2
1917	Not available	Not available	.....
1918	276,350,000	1,139,291,000	24.3
1919	264,320,000	1,474,719,000	17.9

Year	To United States		Per cent from Canada
	From Canada	From all countries	
	bd. ft.	*bd. ft.*	
1912	870,323,000	905,152,000	96.2
1913	1,021,810,000	1,090,628,000	93.7
1914	892,575,000	924,567,000	96.5
1915	908,614,000	929,006,000	97.8
1916	1,179,976,000	1,200,077,000	98.3
1917	Not available	Not available	.....
1918	1,183,015,000	1,206,027,000	98.1
1919	1,119,244,000	1,144,187,000	97.8

The Lumber Industry.—The Dominion Bureau of Statistics reports for the year 1919 some 3,410 sawmills. These mills are distributed by provinces as follows:

TABLE 265.—SAWMILLS IN CANADA.

Alberta	34	Quebec	1,419
New Brunswick	249	Yukon	1
Prince Edward Island	63	Manitoba	38
British Columbia	258	Ontario	852
Nova Scotia	486	Saskatchewan	10

The total capital invested in the lumber industry is given for the year 1919 as $231,203,247. The total number of persons employed in the lumber industry was 73,111, whose aggregate earnings for the year were nearly $61,000,000. Of the wage earners employed in the lumber industry, 34,359 were in the woods and 34,461 in the mills, the remaining being superintendents, managers, and office clerks. The growth of the lumber industry is shown in Table 266.

TABLE 266.—CUT OF SAWN MATERIAL

Year	Volume of trees cut in forest	Volume of lumber produced	Value of lumber produced
	cu. ft.	*bd. ft.*	
1908	697,536,667	3,348,176,000	$54,338,036
1909	794,779,583	3,814,942,000	62,819,477
1910	927,427,500	4,451,652,000	77,503,187
1911	1,024,625,417	4,918,202,000	75,830,954
1912	914,525,625	4,389,723,000	69,475,784
1913	795,133,750	3,816,642,000	65,796,438
1914	822,136,250	3,946,254,000	60,363,369
1915	800,557,500	3,842,676,000	61,919,806
1916	727,197,917	3,490,550,000	58,365,349
1917	864,938,125	4,151,703,000	83,655,097
1918	828,040,125	3,974,631,000	103,697,620
Average 1908–1918 (inc.)	836,082,292	4,013,195,000	$70,342,283

The annual cut of saw timber from 1908 to 1918 increased from 697,536,667 to 828,048,125 cubic feet, or 19 per cent. While the highest cut evidently occurred in 1911 and since then there was a slight decrease, the total value of the product decreased from 1910 to 1916, after which it rose sharply as lumber prices advanced. Judging by the recent figures published by the Dominion Bureau of Statistics, the lumber cut of 1919 was nearly as large as that of 1910—about 4½ billion board feet.

The Pulp Industry.—The pulp industry in Canada shows a truly phenomenal growth. In 1908 the total amount of wood pulp produced was 201,450 short tons; in 1918, 1,557,193 short tons, or an increase of 673 per cent. The value of the product increased from $3,420,000 in 1909 to $72,646,000 in 1918, or 2,024 per cent. The growth of the industry for the period between 1908 and 1918 is shown in Table 267.

In 1918 the number of active pulp and paper mills was 94 and the value of production of pulp and paper amounted to $119,309,434. The total cut of pulpwood for manufacture and for export in 1918 was 3,560,280 cords, of which the quantity cut for export was 1,349,536

cords. The capital investment in the pulp and paper industry was $241,344,704. Salaries and wages for the same year amounted to $26,974,225, and the number of persons working for wages amounted to 23,934, while the number of persons employed on salary was 1,929.

Forestry Movement and Legislation.—The forest administrations of the Dominion government and of the provinces of Ontario, Quebec, New Brunswick, and British Columbia provide for a system of licenses granted only for timber cutting, the crown retaining the title to the land. These licenses stipulate that no unmanufactured timber can be exported. Another important provision applicable throughout the Dominion is compulsory patrol of railway lines for the prevention of fires. The most important piece of legislation in connection with forest lands administered by the Dominion is the forest reserves and parks act, which provides for setting aside areas for forest reserves and Dominion parks, and for regulation of such areas.

Tree planting material is distributed by the Dominion government, and expert advice is furnished to farmers and woodlot owners throughout Canada. No provision is made for remission of taxes as an incentive to timber production.

The provinces of British Columbia, Ontario, Quebec, New Brunswick,

TABLE 267.—CONSUMPTION OF PULPWOOD AND PRODUCTION OF WOOD PULP

Year	Volume of pulpwood consumed		Quantity of wood pulp produced	Value of wood pulp produced
	Equivalent in standing timber	Volume at mill		
	Cu. ft.	*Cords*	*Tons*	
1908	54,312,412	482,777	201,450	$3,420,601
1909	69,989,512	622,129	445,408	7,772,370
1910	67,329,787	598,487	474,604	8,215,395
1911	75,632,400	672,288	496,833	9,385,175
1912	97,429,725	866,042	682,632	11,673,007
1913	124,766,325	1,109,034	854,624	16,947,194
1914	137,742,300	1,224,376	934,700	19,507,189
1915	158,156,550	1,405,836	1,074,805	27,386,031
1916	198,552,600	1,764,912	1,296,084	40,217,487
1917	236,737,575	2,104,334	1,464,154	64,354,453
1918	248,708,700	2,210,744	1,557,193	72,646,177
Average 1908–18 (inc.)	133,578,000	1,187,360	862,044	$25,593,189

and Nova Scotia have general legislation covering fire protection in their forests; laws governing taxation, maintenance of timber supply, and export of unmanufactured timber; and laws providing for forest reserves and parks, and regulating uses of forests for hunting and recreation. A feature common to several of the provinces is provision for a "closed" season" for fires, during which time permits to burn in forest areas must be obtained. The services of experts are furnished in all the provinces except Nova Scotia, although owing to shortage of personnel their assistance is restricted to dealing with general inquiries. An effort is made to encourage the regeneration of the forests by fire protection and, in some provinces, also by cutting regulations. Nurseries are maintained in Ontario and Quebec, which provide planting material for distribution and for replanting projects. The question of remitting taxes on forest property for the purpose of encouraging private enterprise in reforestation is under consideration in several of the provinces.

Forest Organization.—Timber lands are administered by the Department of the Interior through three branches; the forestry branch, the timber and grazing branch, and the Dominion parks branch. The Board of Railway Commissioners of Canada also have certain jurisdiction in forestry matters. The Board of Railway Commissioners has done very effective fire protection work along lines subject to its jurisdiction.

The forests of the provinces of British Columbia, Ontario, Quebec, and New Brunswick are each managed through a special forestry branch, aided by administrative and technical personnel. In the province of Nova Scotia, which has no forestry department, the authority is the Commissioner of Crown Lands.

Private Forestry Activities.—Wood-using industries of Canada have recently become interested in the practice of forestry, and fourteen paper and lumber manufacturing companies in eastern Canada employ technical personnel for silvicultural operations, timber estimates, and supervision of timber cuttings. Price Brothers and Company, Quebec, are setting out 300,000 transplants in a nursery; the Laurentide Company, of Grand' Mere, planted 1,000,000 trees in 1919, and transplanted 1,250,000; and the Riordan Pulp and Paper Company, Montreal, planted 750,000 trees in 1919. The last two firms, which are pioneers among wood-using industries in reforestation, are working toward an annual planting program of 2,000,000 trees.

Professional and Other Societies Interested in Forestry.—There are two professional forestry organizations in Canada, the Canadian Forestry Association and the Canadian Society of Forest Engineers. The former is an educational society of 11,000 members, founded in 1900. Its publicity work is carried on through lectures, publications, exhibits, etc. The objects of the Canadian Society of Forest Engineers are to

discuss technical and professional matters, encourage mutual acquaintance among the members, cultivate esprit de corps, and promote the interests of the profession.

Educational.—The University of Toronto, the University of Laval, Quebec, and the University of New Brunswick offer four-year courses in forestry leading to the degree of Bachelor of Science in Forestry. The courses include laboratory and field work in addition to lectures.

A ranger school, offering a five-month course, has been established at the University of British Columbia at Vancouver, in connection with the work of rehabilitation of returned soldiers. The course is adapted to training men as forest rangers in the Provincial and Dominion Forestry Services.

Probable Future.—With a comparatively small population, a large forest area, and a small cut per acre, Canada, with proper fire protection, could considerably increase her present cut of both timber and pulpwood. Canada is one of the few countries which could still increase her cut for export trade. The total stand of merchantable saw timber in Canada was estimated at approximately 123 billion cubic feet and of pulpwood 104½ billion cubic feet. It is estimated that only one-half of the stand of saw timber, or 61½ billion cubic feet, and one-half of the pulpwood, or 52 billion cubic feet, can be considered commercially accessible. At the present rate of cutting and without provision for maintaining the land productive, the supply of commercially accessible saw timber would be exhausted in about 70 years and the supply of pulpwood in about 170 years. The cut of saw timber since 1912 shows a slight decrease. One-third of the cut is exported. Since the volume of export has increased, the decrease in cut must be entirely due to the falling off in domestic consumption. This condition is either temporary or is caused by increasing difficulty in finding easily accessible loggable tracts. The growth in population and in the industries, which are still in the early stage of development, will demand greater quantities of saw timber for home consumption and export trade. The demand for pulpwood in particular is increasing with great rapidity; and as the supplies of pulpwood are exhausted in the United States, Canada will become more and more the chief source of supply, if not of unmanufactured pulpwood, certainly of wood pulp and paper. The drain upon the pulpwood forests of Canada will be very great in the near future, and the supplies will probably be exhausted much sooner than the figures of present supply and rate of utilization would seem to indicate. The United States will remain, as it is now, the nearest and best customer for Canada's timber and pulpwood. Canada will supply, also in increasing amounts, the markets of Australia, New Zealand, South America, and Japan.

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THE DOMINION OF NEWFOUNDLAND

Forest Area.—The total land area of Newfoundland is 42,000 square miles. Of this about one-fourth, or not more than 10,000 square miles (6,400,000 acres), is wooded. With a population of 243,000 the forest area is about 27 acres per capita. The present area may still be considered as the original forest area of the colony. The decrease of the forests through cutting is very slight. The greatest loss so far has occurred through ravages of fire. Newfoundland is mainly pulpwood country; it has been found that it is not profitable to undertake logging operations to get out the scattered white pine, larch, spruce, and fir for lumber purposes except when combined with logging operations for pulpwood.

Character of the Forest.—Spruce and fir, combined with a small percentage of white pine, constitute the bulk of the utilizable timber of the country. The timbered areas of the colony are, as a rule, found in the valleys of the larger rivers and their tributaries and on the banks of the lakes and ponds. In most cases the forests are confined to strips from 1 to 2 miles wide along the rivers and around the lakes. Although there are some timbered areas in other places, the timber is scattering and usually of small size, and therefore at best suitable only for pulpwood. The best timbered sections of the streams draining toward the east coast are as follows: Gander River, Dog Bay waters, Indian Arm River, Exploits River, including the rivers and lakes tributary thereto: the Halls Bay waters, and the rivers flowing into the head and south side of White Bay and into Baie Verte. Those emptying on the west coast are: Grand Pond waters, Deer Lake and Humber River with the Upper

Humber and Birchy Lake, Harry's Brook and the other rivers flowing into Bay St. George, and the rivers flowing into Bay St. John, Bonne Bay, and Hawke's Bay. The timbered country on the waters of Bonne Bay extends inland in a southerly direction for a considerable distance, while the extent of the timbered section from Bonne Bay north is limited by the foothills of the Long Range Mountains, which lie from six to eight miles back from the sea coast.

On the south coast there are some areas of timbered country lying as a rule at the heads of the bays and along the lower reaches of the rivers, but there is no authentic information as to the existence of any extensive timber areas on the upper waters of the rivers emptying on this coast. In some sections a good deal of the larger timber has been cut, but there still remain very considerable areas of large timber and quantities of trees suitable for pulpwood.

The principal forest trees are:

TABLE 268.—PRINCIPAL TREES, NEWFOUNDLAND

Spruce (*Picea nigra*)	Yellow birch (*Betula lutea*)
Balsam fir (*Abies balsamea*)	Cherry birch (*Betula lenta*)
White pine (*Pinus strobus*)	Sugar maple (*Acer saccharum*)
Red pine (*Pinus resinosa*)	Black ash (*Fraxinus nigra*)
White spruce (*Picea alba*)	American elm (*Ulmus americana*)
American larch (*Larix laricina*)	Aspen (*Populus tremuloides*)
White birch (*Betula papyrifera*)	

Spruce and fir predominate. Pine is found in some sections of the Gambo, Gander, Exploits, Hall's Bay, Dog Bay, and Grand Lake districts. The largest proportion of birch is found on the west coast.

Stand.—The total stand is roughly estimated at 64,000,000 cords of pulpwood and 6,400,000,000 board feet of lumber. In other words, the average yield per acre is 10 cords of pulpwood and 1,000 board feet of lumber. This estimate includes only pines, spruce, and balsam fir.

Character of Ownership.—The land area under forest is owned by the government. All the timbered areas except those lying within three miles of the seashore, which have been reserved from such license, are held under license by private parties or by companies. The licenses are issued for a term of 99 years on the payment of an annual rental at the rate of $2 per square mile. During this term the holder has the right to cut timber on lands described in the license. In case the timber is cut for lumber there is an additional royalty of 50 cents per thousand board feet on the timber cut on the area, except that manufactured into pulp and paper, which is not subject to royalty.

Annual Cut and Consumption.—The annual cut amounts to about 70,000,000 board feet of lumber and about 70,000 cords of pulpwood. Practically all the wood which is manufactured into pulp is exported to

the United Kingdom, while the lumber is used almost exclusively in the colony. The per capita consumption of lumber, therefore, exclusive of firewood, is about 300 board feet (about 60 cubic feet). The total value of the whole lumber product, which includes cooperage stock, shipbuilding supplies, piles, and pit props, amounts to about $1,000,000 per annum. The per capita use of fuelwood in Newfoundland can not be very different from that in Canada, i.e., 193 cubic feet. The total per capita consumption, therefore, is about 255 cubic feet. The total annual utilization of Newfoundland, including saw lumber (14 million cubic feet), and firewood (47 million cubic feet), is 61 million cubic feet.

Annual Growth.—No figures are available as to the increment of the forests of Newfoundland; but since a great part of them are still virgin forests, where decay nearly equals growth, and since forest fires are prevalent, it may be assumed that under present conditions the increment is balanced by waste through fire. The total annual drain upon the forests, therefore, amounts to about 67 million cubic feet.

Probable Future.—It is unlikely that lumber production will ever increase beyond the limits of local consumption. Lumber production will be incidental to cutting for pulpwood, because the large white pine and spruce grow only scatteringly and it would be a wasteful and unprofitable business to operate exclusively for saw log material. The only possibility of increasing lumber production is with hardwoods. These may be utilized for tool-handle or spool stock, or a box shook industry may be established on the island to supply wooden boxes to the foreign trade. There is a considerable amount of ash and birch, especially on the west side of the island, for handle and spool stock, and a large amount of small spruce and fir well suited for box manufacture.

It is different, however, with the wood pulp industry. The large amount of available material, together with abundant water power and the law prohibiting the exportation of pulpwood, provides a great opportunity for the development of the pulp and paper industry in the colony. Newfoundland can probably develop the pulp industry so as to export at least 300,000 tons of paper per annum. A ready market for this product is found either in Europe or the United States, because of direct water communication with Canada, the United States, and England. In 1914 Newfoundland exported to the United Kingdom 52,000 tons of wood pulp.

Many of the London papers are now using pulp and paper produced in Newfoundland. There are two large pulp and paper mills, one owned by the Anglo-Newfoundland Development Company and the other by the Albert Reed Company, of London. The Anglo-Newfoundland Development Company, known locally as the "A. N. D." Company, in 1905 located pulp and paper mills in Newfoundland after spending three

years in seeking an adequate supply of pulpwood elsewhere. The company secured a forest area of some 2,176,000 acres in the center of the island. From Grand Falls on the Exploits River the company secured the necessary power, and it has direct communication from the mills to tidewater at Botwood. The company cuts about 60,000,000 feet of timber, equivalent to 120,000 cords of pulpwood. The news pulp output of the mills is from 190 to 200 tons per day, with a surplus production of ground pulp for export averaging 30 tons per day. At the time of their completion in 1912 the mills were the largest in the world. They now supply the requirements of four British newspapers.

The A. E. Reed Company owns the so-called Bishop Falls Mills. These mills were completed and commenced operation in 1911. The company holds licenses for 524,800 acres. The mills turn out 140 dry short tons per 24 hours. Most of the product is shipped to England. There are some pulp mills connected with lumber operations as, for instance, at Campbellton on Notre Dame Bay. Before the war, in 1913, Newfoundland supplied the United Kingdom with newspaper (on reels), to the extent of 17.4 per cent of its total imports. In 1915, during the war, when there was a great decrease in the total amount of newspaper imported into the United Kingdom, Newfoundland contributed as high as 44.7 per cent of the entire amount. At present, Newfoundland is ahead of Norway as an exporter of newspaper to the United Kingdom. The growth of the pulp and paper industry in Newfoundland may be seen from the following figures:

Year	Paper	Pulp
	tons	*tons*
1910.....	7,900	6,900
1911.....	21,100	27,200
1912.....	26,800	42,100
1913.....	44,400	57,500
1914.....	40,077	51,605

Another field of export trade is afforded by pit timber. During the war, when it became evident that the supplies of pit wood, which are so essential for the coal mines of the United Kingdom, would be largely curtailed, the English Board of Trade took steps to ascertain to what extent Newfoundland could meet the requirements. It was found that very large areas of suitable timber existed in the island, a considerable proportion being close to the seashore or to many bays and rivers and therefore easily transported to the various points where

it could be loaded on steamers. The timber rights within three miles of the shore over the whole island are reserved by the government. Ordinarily any one may cut timber on this three-mile limit for firewood, house building, boat making, and other purposes, but not for export except in the form of pulp. After the outbreak of the war, the government by a special act sanctioned the export of pit wood, and this concession is still in force. In the estimate of the Special Commission of Inquiry, Newfoundland could supply annually 300,000 cords of pit wood. Whether Newfoundland will actually be able to deliver a large supply of pit wood will depend upon the competition which it encounters in the Baltic countries after conditions have become settled.

The Forestry Movement.—A forest fire patrol system has been in force since 1911 under government auspices, assisted by a committee which consists of representatives of the large timber limit owners and the Minister of Agriculture and Mines, who is chairman. The government appropriates the sum of $4,000 for this service and the holders of timber licenses contribute to the funds of the committee in proportion to the areas held by them. The rate fixed in 1919 by the committee was about 50 cents per square mile. Such subscriptions, however, are optional, there being no provision in the law to compel licensees to contribute. The total amount collected in 1919, including the government's subsidy, was close to $9,000, subscribed by 22 companies. The number of rangers employed was 44, and during the season they dealt with 1,275 fires. As the pulp and paper industry develops on the island, this patrol system will undoubtedly be further extended.

Labrador

The peninsula of Labrador, with its 600 miles of coast and 120,000 square miles of territory, is a dependency of Newfoundland. The boundary between Labrador and Canada is a line running due north and south from Blanc Sablon in the strait of Belle Isle to latitude 52° N. Newfoundland, therefore, owns the outlets to the Atlantic of all the large areas drained by Sandwich Bay and Hamilton Inlet and the lesser fiords of the indented coast.

No authentic information exists as to the extent of the timber country of Labrador, but from the Canadian Geological Report of 1892-1895 and from information gathered from local sources, as well as from writings of Dr. W. T. Grenfell, it is known that the peninsula is well wooded in many parts. The most abundantly timbered sections are reported to be in the neighborhood of Hamilton Inlet, including Hamilton River and the other rivers flowing into that Inlet, the rivers flowing into Sandwich Bay, and some of the rivers emptying on the coast between Sandwich Bay and Blanc Sablon in the straits of Belle Isle. The timber

trees, very similar to those of Newfoundland, are white and black spruce, balsam fir, larch, jack pine, cedar, white birch, poplar, and aspen. The forests are reported to be almost continuous over the southern portions to 53° N. There is no authentic information as to the quantity of timber on these areas. The greatest portion, however, appears to be suitable for pulp only. Labrador, therefore, may eventually become the center of a large wood pulp industry. In the meantime, it is a source of pulpwood to some of the mills operating in Newfoundland.

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THE UNITED STATES

Extent of Forests.—Approximately 550,000,000 acres, or 28.9 per cent of the total land surface of 1,903,200,000 acres in continental United States, exclusive of Alaska, is classed as forest land. This is 5.2 acres per inhabitant. Not all is now productive forest, however, for the estimate includes vast areas which have been so devastated by careless lumbering and by fires that they will not spontaneously produce forest crops of economic value except after the lapse of many decades, nor is there at present any prospect that they will soon be restocked by planting or other artificial measures. This class of land includes, in round numbers, 81,000,000 acres, widely scattered over the country, particularly in the northern and the southeastern States. Of the other 469,000,000 acres, about 80,000,000 acres is woodland, covered with a more or less open stand of short, crooked trees which furnish fuel, fencing, and some small building material, but are not now and never were

capable of producing sawtimber on a commercial scale. The productive forest, therefore, covers only 389,000,000 acres, or 20.4 per cent of the land surface.

When the English first settled the country three hundred years ago the extent of forest was much greater, especially in the eastern, southeastern, and central States. About 822,000,000 acres was originally covered with timber forest, and about 100,000,000 acres was lightly wooded with juniper, piñon pine, mesquite, stunted oaks, and other species.

The distribution of the original and the remaining forests, exclusive of woodland, by regions[1] is shown in Table 269.

Character and Distribution of Forests.—In general, there are three broad forest belts. One stretches inland from the Atlantic Ocean to beyond the Mississippi River, with its farthest limits at approximately the 97th meridian. The second extends eastward from the Pacific coast across the Sierra and Cascade ranges. The third, which is more or less interrupted, lies along the Rocky Mountains and outlying ranges, from the Canadian boundary to Mexico. Between the eastern and Rocky Mountain forests is a wide expanse of grassland, with occasional tree growth along the streams, while the region between the Rockies and the Sierra-Cascade ranges and also east of the Rockies in New Mexico and Texas is a more or less desert country, covered for the most part with low shrubs, or in more favorable situations with open woodland of stunted trees. On the higher mountains there are forests of better timber of varying density.

Not only are the forests very unevenly distributed over the country, but their composition exhibits the greatest variation from one region to another. Not including the tropical species of southern Florida and the Mexican species whose range extends only a short distance north of the boundary, there are more than 500 arborescent species indigenous to the United States. About 100 of these now have a recognized economic

[1] For purposes of this discussion, the States are grouped in these regions:

New England—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

Middle Atlantic—New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia.

Lake States—Michigan, Minnesota, Wisconsin.

Central States—Ohio, Indiana, Illinois, West Virginia, Kentucky, Tennessee, Iowa. Missouri, Kansas, Nebraska, North Dakota, South Dakota (except extreme west).

South Atlantic and East Gulf—Virginia, North Carolina, South Carolina, Georgia, Alabama, Florida.

Lower Mississippi—Mississippi, Arkansas, Louisiana, eastern Oklahoma, eastern Texas.

Rocky Mountain—Montana, Idaho, Wyoming, Colorado, Utah, Nevada, New Mexico, Arizona, western Oklahoma, western Texas.

Pacific Coast—California, Oregon, Washington.

value, and many others are used to a limited extent for various special purposes. With less than half a dozen exceptions, the species composing the eastern and western forests are altogether different. Broadleafed trees predominate over about half of the eastern forest, being represented by a great many species of high economic value, and they are also found to a greater or less extent in the conifer forests of the northern and southern States. In the Rocky Mountain and Pacific coast forests, on the other hand, hardwoods occupy only an insignificant part of the area, and are usually small, stunted trees of very little economic importance.

The distribution of hardwoods and conifers in the different regions is shown in Table 270.

No figures are available as to the division between hardwoods and conifers of the 81,000,000 acres of devastated land which is included in the above totals. In general, however, most of this land, probably at least 70 million acres, originally bore coniferous species. The total areas actually bearing timber are approximately 223,000,000 acres of conifers and 165,000,000 acres of hardwoods.

The five main divisions into which the forests of the United States may be broadly classified are:

(1) Northeastern forest, in the northern parts of New England,

TABLE 269.—DISTRIBUTION OF FORESTS, UNITED STATES

Region	Original forest	Present forest		
		Total area	Ratio to total land area	Land not restocking with commercial stand
	acres	*acres*	*per cent*	*acres*
New England	38,908,000	25,708,000	65.0	5,575,000
Middle Atlantic States	69,610,000	28,678,000	40.0	6,430,000
Lake States	103,680,000	57,100,000	46.1	20,500,000
Central States	170,550,000	60,182,000	14.0	2,220,000
South Atlantic and East Gulf States	170,240,000	99,000,000	54.4	20,720,000
Lower Mississippi Valley	128,400,000	78,865,000	48.5	13,755,000
Rocky Mountain States	63,720,000	60,842,000	8.8	5,250,000
Pacific Coast States	77,120,000	59,100,000	29.0	6,700,000
Total	822,228,000	469,475,000	24.7	81,150,000

New York, and the Lake States, and extending southward along the Appalachian Mountains to northern Georgia.

(2) Central forest, extending from southern New England westward to the plains beyond the Mississippi River, and southward to the southern coastal plain.

(3) Southern forest, occupying the Atlantic coastal plain from New Jersey to Texas.

(4) Rocky Mountain forest, which covers the higher interior mountain ranges from Canada to Mexico.

(5) Pacific coast forest, in California, Oregon, and Washington.

Northeastern Forest.—The northeastern forest was originally characterized by the predominance of conifers, of which white pine (*Pinus strobus*) and red spruce (*Picea rubra*) were by far the most important. First the pine and later the spruce were taken out by the lumbermen, until now but little of the original growth of either remains. The composition of the northern forest varies widely with differences in topography, soil, climate, and history. In swamps and at high elevations, particularly in the northern parts of the region, the spruces and balsam fir (*Abies balsamea*) predominate, often in pure stand, or associated with tamarack (*Larix laricina*), arborvitae or white cedar (*Thuja occidentalis*), and various hardwoods. On better drained sites of medium elevation are found the typical northern hardwoods, beech, birch (yellow and white), and hard maple, often with considerable hemlock (*Tsuga canadensis*) and more or less spruce and pine in the mixture. Pure stands of white pine occur in many small second-growth woodlots in the northeastern States, and there are still a few remnants of the original stand of this species left in the northern part of the Lake States, where is is usually associated with Norway or red pine (*Pinus resinosa*).

TABLE 270.—DISTRIBUTION OF HARDWOODS AND SOFTWOODS, UNITED STATES

Region	Conifers	Hardwoods
	acres	*acres*
New England	16,208,000	9,500,000
Middle Atlantic States	11,550,000	17,128,000
Lake States	28,150,000	28,950,000
Central States	3,220,000	56,962,000
South Atlantic and East Gulf	71,700,000	27,300,000
Lower Mississippi Valley	42,664,000	36,201,000
Rocky Mountain States	60,842,000	.....
Pacific Coast States	59,100,000	.....
Total	293,434,000	176,041,000

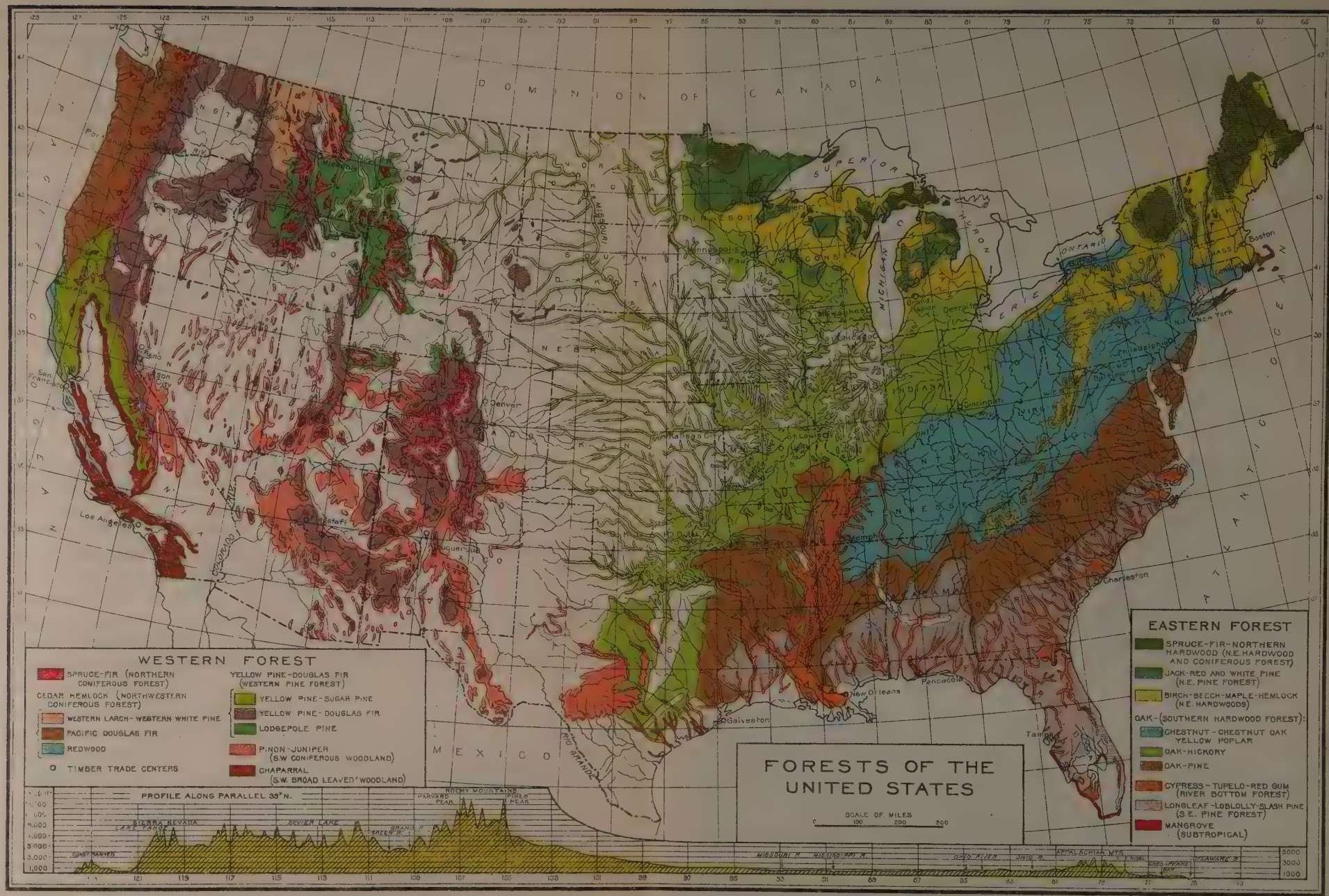
FORESTS OF THE UNITED STATES
SCALE OF MILES
0 100 200 300
WESTERN FOREST
SPRUCE-FIR (NORTHERN CONIFEROUS FOREST)
CEDAR-HEMLOCK (NORTHWESTERN CONIFEROUS FOREST)
WESTERN LARCH-WESTERN WHITE PINE
PACIFIC DOUGLAS FIR
REDWOOD
TIMBER TRADE CENTERS
YELLOW PINE-DOUGLAS FIR (WESTERN PINE FOREST)
YELLOW PINE-SUGAR PINE
YELLOW PINE-DOUGLAS FIR
LODGEPOLE PINE
PINON-JUNIPER (S.W CONIFEROUS WOODLAND)
CHAPARRAL (S.W. BROAD LEAVED WOODLAND)
EASTERN FOREST
SPRUCE-FIR-NORTHERN HARDWOOD (N.E. HARDWOOD AND CONIFEROUS FOREST)
JACK-RED AND WHITE PINE (N.E. PINE FOREST)
BIRCH-BEECH-MAPLE-HEMLOCK (N.E. HARDWOODS)
OAK-(SOUTHERN HARDWOOD FOREST):
CHESTNUT-CHESTNUT OAK YELLOW POPLAR
OAK-HICKORY
OAK-PINE
CYPRESS-TUPELO-RED GUM (RIVER BOTTOM FOREST)
LONGLEAF-LOBLOLLY-SLASH PINE (S.E. PINE FOREST)
MANGROVE (SUBTROPICAL)
PROFILE ALONG PARALLEL 39° N.
SIERRA NEVADA
LAKE TAHOE
SEVIER LAKE
GREEN R.
GRAND R.
ROCKY MOUNTAINS
HARVARD PEAK
PIKES PEAK
COAST RANGES
MISSOURI R.
MISSISSIPPI R.
OHIO RIVER
OHIO R.
APPALACHIAN MTS.
CHESAPEAKE BAY
DELAWARE R.
DOMINION OF CANADA
MEXICO
Minneapolis
St. Paul
Superior
Milwaukee
Chicago
Grand Rapids
Detroit
Buffalo
Boston
New York
Philadelphia
Baltimore
Cincinnati
St. Louis
Kansas City
Denver
San Francisco
Los Angeles
Albuquerque
Memphis
Charleston
New Orleans
Pensacola
Galveston
Tampa
SUPERIOR
MICHIGAN
HURON
ERIE
ONTARIO
PACIFIC OCEAN
ATLANTIC OCEAN

PLATE XI
FORESTS OF THE UNITED STATES

(*Facing page 522*)

Of the original 150,000,000 acres of northern forest, only about 15,000,000 acres remains uncut. Some has been cleared, and about 30,000,000 acres is classed as non-productive as a result of forest fires following lumbering. About 60,000,000 acres bears stands of young timber, with a much larger proportion of hardwoods and of relatively inferior species than were present in the original forest. Much of the cut-over pine land is restocking with pure or nearly pure stands of aspens (*Populus tremuloides* and *P. grandidentata*) and paper birch (*Betula papyrifera*) or of jack pine (*Pinus banksiana*), which is especially abundant on sandy lands in the Lake States.

Central Forest.—The central forest region is characteristically one of hardwoods. The oaks, of which there are several commercially valuable species, are the most abundant and of greatest economic importance. Associated species include chestnut, hickories, yellow poplar (*Liriodendron tulipifera*), elm, black walnut, ash, and many others. Some pines are found in this region, occasionally in pure stands, but more often mixed with the hardwoods. The most characteristic pine is shortleaf (*Pinus echinata*) which is generally distributed through the Piedmont region and westward to Oklahoma. Others are pitch pine (*P. rigida*) and scrub pine (*P. virginiana*). Red cedar (*Juniperus virginiana*) is also common in much of the hardwood region.

Of approximately 281,000,000 acres originally comprised in the central forest, more than 60 per cent has been cleared to make room for agriculture, and most of the rest has been culled over repeatedly for the best timber, with the result that not more than 5 per cent, or 14,000,000 acres, of virgin timber remains. Comparatively little of the forest land in this region, probably about 5,000,000 acres, is classed as non-productive because of devastation. The area of culled and second-growth forest, much of which is in very poor condition silviculturally and incapable of producing large quantities of sawtimber, is about 90,000,000 acres.

Southern Forest.—The forest of the southeastern coastal plain was and is still predominantly a forest of yellow pines, of which the most important are longleaf pine (*P. palustris*), loblolly pine (*P. taeda*), slash pine (*P. heterophylla* or *P. caribaea*) and shortleaf pine (*P. echinata*). These, especially longleaf and slash pines, form extensive pure stands. Loblolly and shortleaf also occur in pure stands on abandoned fields; in the original forest they were more frequently mixed with hardwoods. The hardwoods of the central region occur all through most of the pine belt, but are of comparatively minor importance except on the alluvial bottom lands. In those places the pines give way to stands of mixed hardwoods such as various species of oak, hickory, ash, elm, sycamore, soft maple, red gum (*Liquidambar styraciflua*), and others. On lands flooded during a considerable portion of the year cypress (*Taxodium dis-*

tichum) and tupelo gum (*Nyssa aquatica*) are the most valuable species. There are also pure stands of southern white cedar (*Chamaecyparis thyoides*) in some of the coastal swamps. The extreme southern portion of Florida has a forest composed of many tropical species, similar to the tree growth of the West Indies.

Of the original forest area of some 250,000,000 acres, only about 31,000,000 acres of virgin timber is left. About three-fourths of this, or 23,000,000 acres, is yellow pine. Forest devastation has gone farther in this region than in any of the others, with the result that about 34,000,000 acres, 90 per cent of which is pine land, is classed as non-productive. Approximately 70,000,000 acres bears second-growth timber.

Rocky Mountain Forest.—In the Rocky Mountain region the composition of the forests bears a much more definite relation to altitudes than is the case in the East. At the lower elevation the characteristic trees are various piñon pines, junipers, and scrub oaks. Western yellow pine (*P. ponderosa*) is the typical tree of the next belt. It is widely distributed over almost the whole region, excepting the central Rockies, and occurs either in pure stands or in a great variety of mixtures, its principal associates being Douglas fir, white fir (*Abies concolor*), and in the north, western larch (*Larix occidentalis*). At higher altitudes are stands of Douglas fir and lodgepole pine (*P. contorta*). Dense pure stands of this species occupy extensive areas in the central and northern Rocky Mountains. Much of it is on sites where the original forest of fir or spruce has been destroyed by fire. The highest belt of commercial forest consists of Engelmann spruce, alpine fir, and various minor species. In Colorado and Utah large areas of burned-over land in this zone are occupied by dense stands of aspen (*Populus tremuloides*). In northwestern Montana and northern Idaho occurs a type of forest very similar to that on the Pacific coast, namely the western red cedar-western hemlock-western white pine forest, composed of *Thuja plicata, Tsuga heterophylla,* and *Pinus monticola,* with various other conifers. Per unit of area this is economically the most valuable forest of the entire Rocky Mountain region.

The distribution of forest within this region is very uneven. The high plateaus of Arizona, New Mexico, and Utah are well timbered, while the intervening country is almost treeless. Nevada has only a small amount of timber forest on the higher mountains. The central Rockies in Colorado are fairly well covered by tree growth, except for the extensive areas of land above timber line. In eastern Wyoming, eastern Montana, and southern Idaho the bodies of forest are comparatively small and isolated, while northern Idaho and western Montana have a fairly continuous forest cover.

Except in the extreme north and the extreme south, the Rocky Moun-

tain forest has served principally to supply local requirements for timber. It has suffered far worse from devastating fires than from wasteful logging. Of an original area of about 65,000,000 acres, not including scrub woodland, over half, or 38,000,000 acres, bears virgin timber, about 4,000,000 acres has been cleared, 5,000,000 acres is non-productive as a result of fires, and about 18,000,000 acres is covered with culled-over old timber or young growth.

Pacific Coast Forest.—The forest of the Pacific coastal region contains the heaviest stands and the largest timber in North America, and is probably not surpassed in this respect by any forest in the world. While there are a few hardwoods of some economic importance, such as tanbark oak (*Quercus densiflora*) and several other oaks, laurel, Oregon maple, and ash, and others of little value, the forests in general are entirely composed of coniferous species. Within the region are four fairly distinct sub-regions, each characterized by a different type of forest. The coast ranges of northern California are occupied by heavy stands of redwood (*Sequoia sempervirens*), which reaches immense size and age. Logging has been carried on in the redwood belt for many years, and much of the choicest timber has been cut and the land cleared for farming. Large supplies of redwood still remain, however.

The coastal belt of Oregon and Washington, eastward to the summit of the Cascade range, is the Douglas fir region, characterized by dense stands of large timber, of which Douglas fir (*Pseudotsuga taxifolia*) is the predominating species. Associated with it are western hemlock, western red cedar, Sitka spruce (*Picea sitchensis*) and several species of fir (*Abies*). Port Orford cedar (*Chamaecyparis lawsoniana*), which is highly valued for several special uses, is restricted to southwestern Oregon. The timber in the Douglas fir forest is exceeded in size only by the redwoods. Diameters of 6 feet and heights of 200 to 250 feet are common, while some trees reach considerably larger sizes. This region is now the seat of the largest timber industry in the country, and the industry is still growing. Vast areas have been cut over and others have been destroyed by fire, yet there remains a very considerable amount of virgin timber.

East of the summit of the Cascades the forest is characterized by western yellow pine, mixed with Douglas fir, western larch, and lodgepole pine, with Engelmann spruce and alpine fir at the higher elevations. In eastern Washington there is also considerable western white pine. In eastern Oregon large areas are occupied by pure stands of western yellow pine, in many respects resembling those of Arizona. While extensive lumbering operations have been carried on in parts of this region for several decades, much of it is yet undeveloped.

The Sierra Nevada of California is covered with heavy forests of

western yellow pine, Jeffrey pine (*Pinus jeffreyi*), sugar pine (*P. lambertiana*), incense cedar (*Libocedrus decurrens*) and white fir (*Abies concolor*). The western foothills bear an open growth of oaks and digger pine, with several other species, and at the higher altitudes firs predominate, especially red fir (*Abies magnifica*). The bigtree (*Sequoia gigantea*) occurs locally. The more accessible of these forests have long supplied timber for local requirements as well as for the general market, and fires have been destructive, especially at the higher elevations.

Of a forest originally covering between 75,000,000 and 80,000,000 acres in the Pacific Coast States, a little less than 40,000,000 acres of virgin timber remains. Nearly 7,000,000 acres has been so badly burned that it must be classed as non-productive, and about 13,000,000 acres bears second-growth timber. The rest has been cleared for agricultural or other use.

Stand of Timber.—The volume of sawtimber originally standing in the forests of the United States has been estimated at 5,200,000,000,000 board feet, equivalent to more than 1,100,000,000,000 cubic feet of standing timber. This estimate is probably below the actual stand. Less than one-third of this amount of old growth timber remains, and the total stand including second growth, is now approximately 2,215 billion board feet of sawtimber (485 billion cubic feet) besides 261 billion cubic feet of young timber below sawtimber size. This does not include the stand on the scrub woodland areas of the western States, which may amount to between 15 and 25 billion cubic feet.

As a result of many years of lumbering and repeated fires, together with the clearing of much of the central forest for agriculture, the forests of the East, which originally contained two-thirds of all the sawtimber, now have but 40 per cent of the total, while over half is in the three Pacific coast States. About 80 per cent of the sawtimber is softwood and 20 per cent hardwood.

The stand by kinds of timber in the different groups of States is shown in Table 271.

Ownership.—At the time the United States was established, practically all of the country west of the Appalachian and Alleghany Mountains was public property, and with some exceptions, especially in the Southwest, the same was true of the territory acquired later on the North American continent. For many years it was the policy of the Federal government and of the States, most of which possessed large tracts of land or received them upon admission to the Union, to dispose of their public lands on the most liberal terms, in order to encourage settlement and development of the country. Besides the millions of acres that were sold at a nominal price or granted free to settlers and others, enormous grants were made to highway and railroad companies.

TABLE 271.—STAND OF TIMBER IN THE UNITED STATES BY KINDS AND REGIONS

Kind	Total	New England	Middle Atlantic	Lake	Central	South Atlantic and East Gulf	Lower Mississippi	Rocky Mountains	Pacific Coast
Sawtimber (in millions of bd. ft.):									
Eastern hardwoods	459,675	11,319	29,504	69,350	133,152	83,750	132,600	.....	.....
Oak	157,372	1,510	5,500	8,301	64,712	27,889	49,460	.....	.....
Birch, beech, and maple	90,874	8,143	16,897	36,076	20,505	4,522	4,641	.....	.....
Red gum	44,222	.....	176	.....	3,728	13,400	26,918	.....	.....
Chestnut	19,319	960	3,754	.....	7,989	6,616	.....	.....	.....
Hickory	15,784	40	412	187	6,791	3,183	5,171	.....	.....
Cottonwood and aspen	10,824	374	13	999	2,131	1,340	5,967	.....	.....
Ash	9,988	215	513	1,893	2,929	1,256	3,182	.....	.....
Yellow poplar	9,611	.....	126	7	5,193	4,020	265	.....	.....
Others	101,771	77	2,113	21,887	19,174	21,524	36,996	.....	.....
Eastern softwoods	391,046	38,480	15,353	40,760	11,318	136,827	148,308	.....	.....
Southern yellow pine	257,691	.....	.....	.....	365	121,442	135,884	.....	.....
Hemlock	30,896	1,804	5,036	18,301	3,910	1,845	.....	.....	.....
Spruce and fir	31,572	23,971	2,948	3,772	.....	881	.....	.....	.....
Cypress	22,921	.....	.....	.....	.....	11,208	11,713	.....	.....
White and Norway pine	23,457	9,816	4,037	8,000	515	1,089	.....	.....	.....
Others	24,509	2,889	3,332[1]	10,687	6,528[1]	362	711	.....	.....
Western softwoods	1,364,172	.....	.....	.....	.....	.....	.....	223,141	1,141,031
Douglas fir	595,505	.....	.....	.....	.....	.....	.....	36,934	558,571
Western yellow pine and Jeffrey pine	249,578	.....	.....	.....	.....	.....	.....	66,125	183,453
Western hemlock	95,092	.....	.....	.....	.....	.....	.....	1,092	94,000

[1]Includes small amounts of various species of yellow pine.

TABLE 271.—STAND OF TIMBER IN THE UNITED STATES BY KINDS AND REGIONS—(*Continued*)

Kind	Total	New England	Middle Atlantic	Lake	Central	South Atlantic and East Gulf	Lower Mississippi	Rocky Mountains	Pacific Coast
Sawtimber, etc.—Contd.									
Western softwoods—Contd.									
True firs	91,349	.....	.....	.....	.....	.....	.....	8,870	82,479
Redwood	72,208	.....	.....	.....	.....	.....	.....	.....	72,208
Western white pine and sugar pine	57,071	.....	.....	.....	.....	.....	.....	18,586	38,485
Western red cedar	53,348	.....	.....	.....	.....	.....	.....	4,348	49,000
Lodgepole pine	43,919	.....	.....	.....	.....	.....	.....	39,353	4,566
Spruce	39,822	.....	.....	.....	.....	.....	.....	26,467	13,355
Others	66,280	.....	.....	.....	.....	.....	.....	21,366	44,914
Total sawtimber (millions of bd. ft	2,214,893	49,799	44,857	110.110	144,470	220,577	280,908	223,141	1,141,031
Proportion in each region—per cent	100	2	2	5	7	10	13	10	51
Sawtimber (in millions of cubic feet)	485,062	10,906	9,824	24,114	31,639	48,306	61,519	48,868	249,886
Cordwood (in millions of cubic feet)	260,526	9,944	15,073	26,470	53,479	47,852	56,845	13,025	37,838
Total stand (in millions of cubic feet)	745,588	20,850	24,897	50,584	85,118	96,158	118,364	61,893	287,724
Proportion in each region—per cent	100	3	3	7	11	13	16	8	39

As a result, practically all of the timberland in the East and most of the choicest in the West passed into private ownership, usually in small parcels in the regions suited to agricultural settlement and in very large holdings in the regions which are less susceptible to cultivation.

Only about thirty years ago the policy was adopted of reserving certain public forest lands, to be maintained as forests. Since then the area of national forests has been gradually extended, until it now embraces about 136,000,000 acres within continental United States, not including Alaska. Not all of this is productive forest land, however, for it includes considerable woodland below the forest zone, treeless mountain tops, and many small areas of barren rock and brush or grassland. Other forest lands still owned or controlled by the Federal government are included in the national parks, the unappropriated public domain, and the Indian reservations. Several of the individual States have also begun to set aside or acquire lands for forest production, and many of those in the West still own a certain amount of forest land which was granted to them by the Federal government.

The division of the forest area and stand of sawtimber among the different classes of owners is shown in Table 272.

TABLE 272.—AREA OF FORESTS AND STAND OF SAWTIMBER
Thousands of Acres

Region	Federal		State and municipal	Total public	Private
	National Forest	Other			
Eastern United States	4,578	1,000	6,200	11,778	337,755
Rocky Mountains	48,281	3,400	1,911	53,592	7,250
Pacific Coast	28,294	3,500	1,000	32,794	26,306
Total	81,153	7,900	9,111	98,164	371,311
Per cent	17.3	1.7	1.9	20.9	79.1

STAND OF SAWTIMBER
Billions of Board Feet

Eastern United States	4.2	4.0	10.0	18.2	832.6
Rocky Mountains	145.4	12.2	9.8	167.4	55.7
Pacific Coast	348.0	86.3	39.0	473.3	667.7
Total	497.6	102.5	58.8	658.9	1,556.0
Per cent	23.5	4.8	2.8	31.1	68.9

Annual Growth.—As most of the best forest lands in the United States are not managed with the definite object of raising more timber after the original stand is cut, the aggregate annual growth is only a small fraction of what the forests of the country might produce. The rate of growth naturally varies widely with differences in location and character of the forest. In most of the Rocky Mountain region the growth of timber is slow, while on the Pacific coast and in some sections of the northeast and southeast it is very fast.

Of the 469,000,000 acres of forest land (exclusive of scrub woodland), there is practically no growth on the 81,000,000 acres of devastated land or on the 138,000,000 acres of old-growth timber where natural losses and increases balance. This leaves only 250,000,000 acres on which there is any net increment, and the greater part of it is in very poor condition. The present annual growth is estimated to be as given in Table 273.

In addition to the above amount, there is a little growth of cordwood on the piñon-juniper and other woodland in the southwest. This probably does not exceed 2 or 3 cubic feet per acre for the entire area of about 80,000,000 acres, or possibly 200,000,000 cubic feet altogether.

TABLE 273.—ANNUAL GROWTH, UNITED STATES

Region	Growing area	Annual growth				
		Total	Growth per acre for total forest area	Saw-timber		Cordwood
				Total	Growth per acre for total forest area	
	million acres	*million cu. ft.*	*cu. ft.*	*thousand board feet*	*board feet*	*million cu. ft.*
New England	18.2	474	18.4	609,000	24.0	341
Middle Atlantic	20.4	499	17.4	714,000	24.9	342
Lake	26.5	468	8.2	988,000	17.3	251
Central	50.3	906	15.0	1,458,000	24.2	587
South Atlantic and East Gulf	60.0	1,594	16.1	2,428,000	24.5	1,062
Lower Mississippi	44.3	983	12.5	1,752,000	22.2	600
Rocky Mountain	17.8	365	6.0	461,000	7.6	264
Pacific Coast	12.7	706	11.9	1,262,000	21.4	430
Total	250.2	5,995	12.8	9,672,000	20.6	3,877

Not all of the volume given above can be considered a net addition to the amount of standing timber, for there are heavy losses almost every year, due to fires, storms, and other causes for which no allowance was made in calculating the growth. It has been estimated that these losses aggregate approximately 1,730,000,000 cubic feet a year, including 4,750,000,000 board feet of sawtimber. The net growth, therefore, is only 4,265,000,000 cubic feet, of which a little less than 5 billion board feet is sawtimber, besides the small amount in scrub forests of the southwest.

Annual Cut.—The total amount cut from the forests of the United States averages a little over 24,300,000,000 cubic feet a year. Slightly more than half, or 53 per cent, is coniferous species, and 47 per cent is hardwoods. For fuel, hardwoods are used in greater volume than softwoods, while softwoods predominate in the cut of material other than fuel, comprising about 70 per cent of the total, and 80 per cent of the cut of sawed lumber alone. Of the total cut, fuel comprises 43 per cent, sawed lumber, hewed timbers and shingles 42 per cent, posts, poles, piling, and mine props 9 per cent, pulpwood 2 per cent, and staves, veneer logs, vehicle and furniture stock, and wood for distillation and tanning extract the remaining 4 per cent. Table 274 shows the average amounts cut for various purposes, expressed in terms both of board feet of manufactured product and of cubic feet of standing timber.

The principal lumber-producing region is the yellow pine belt of the southern and southeastern States. Before 1900 the Lake States white pine region held the lead for several decades, and now that the larger bodies of southern pine timber are becoming exhausted the center of production is beginning to shift to the Pacific Coast States. New England and the Middle Atlantic States, formerly heavy producers of white pine, spruce, and hemlock, have fallen far behind, and the same is true of the Central States, whose hardwood forests have been seriously depleted. The lumber cut in the Rocky Mountain States is increasing slowly. The amounts of lumber sawed in the several regions in 1899, 1909, and 1919 are shown in Table 275. The statistics of other materials cannot be distributed accurately according to regions of production.

As the center of production shifted from one region to another, the proportions of the different kinds of timber composing the cut also changed. In 1899 hardwoods comprised 24.6 per cent, in 1909 they were 23.8 per cent, and in 1919 only 20.7 per cent of the total. Oak furnished the largest proportion of the hardwood cut in all three years, while yellow poplar dropped from second place in 1899 to seventh in 1919. During the same period red gum rose from seventh place among the hardwoods to third. The changes in the proportions of the different

TABLE 274.—TIMBER CUT EACH YEAR FROM THE FORESTS OF THE UNITED STATES

Kind of product	Quantity	Equivalent in lumber which could have been sawed from the same trees			Equivalent in standing timber		
		Hardwood	Softwood	Total	Hardwood	Softwood	Total
		millions bd. ft.	*millions bd. ft.*	*millions bd. ft.*	*thousands cu. ft.*	*thousands cu. ft.*	*thousands cu. ft.*
Lumber	40,700,000 M bd. ft	8,700	32,000	40,700	1,905,300	7,008,000	8,913,300
Hewed ties	87,500,000 ties	2,100	525	2,625	840,000	210,000	1,050,000
Pulpwood	4,550,000 cords	200	1,400	1,600	64,350	468,000	532,350
Round mine timbers	250,000,000 cubic feet	375	375	750	162,500	162,500	325,000
Fencing	900,000,000 posts	165	660	825	360,000	1,440,000	1,800,000
Poles	4,250,000 poles	55	200	255	11,700	43,550	55,250
Shingles	8,850,000 M shingles	.....	890	890	.....	194,700	194,700
Vehicle stock, handles, woodenware, furniture, etc	870,000 M bd. ft	850	20	870	196,500	3,190	199,690
Export logs and hewn timber	200,000 M bd. ft	100	100	200	22,500	22,500	45,000
Veneer logs	650,000 M feet logs	560	120	780	101,200	18,400	119,600
Tight staves	286,000,000 staves	380	55	435	83,250	11,990	95,240
Tight heading	21,000,000 sets	140	15	155	29,250	3,250	32,500
Slack staves	1,010,000,000 staves	265	40	305	58,080	8,580	66,660
Slack heading	61,000,000 sets	120	105	225	26,750	22,725	49,475
Hoops	333,000,000 hoops	90	.....	90	19,650	.....	19,650
Piling	1,500,000 pieces	20	70	90	3,900	15,600	19,500
Lath	2,375,000 M lath	.....	.....	.....	.....	.....	.....
Distillation	1,550,000 cords	375	.....	375	163,800	17,550	181,350
Tanning extract	1,250,000 cords	135	.....	135	146,250	.....	146,250
Excelsior	200,000 cords	60	15	75	18,720	4,680	23,400
Fuel wood	110,000,000 cords	.....	.....	.....	7,315,000	3,135,000	10,450,000
Total	.....	14,700	36,500	51,380	11,528,700	12,790,215	24,318,915

NOTE.—Figures on amounts used are in most cases the most recent data available. For lumber the average total cut for the period 1909–1918 was taken (5 prewar and 5 war years). It should be noted that the figures for lumber and those for standing timber do not in all cases represent the same material. Most of the fuelwood, for instance, is cut from trees too small or defective to yield sawed lumber and the same is true of part of the wood cut for pulp, fencing, and other purposes.

conifers are even more striking. Southern yellow pine formed 37 per cent of the softwood cut in 1899 and 48 per cent in 1919; white pine, including both the eastern and the western species, formed 29 per cent in 1899 and only 6 per cent in 1919; during the same 20 years hemlock, including both eastern and western species, dropped from 13 to 6 per cent, while Douglas fir rose from 7 to 22 per cent of the total.

The principal kinds of timber composing the lumber cut in 1899, 1909, and 1910 are given in Table 276.

The total cut of timber and firewood amounts to about 52 cubic feet for each acre of forest land, or 44 cubic feet per acre if the southwestern woodland forest be considered. This is between 5 and 6 times as much as the net growth, which is about 9 cubic feet per acre for the timber forest alone, or 8 cubic feet for the whole area including woodland.

Exports.—Since the decade following the first settlement of New England, when the shipment of white pine ship-timbers and clapboards to England and to the West Indies began, lumber export has been a very important factor in American foreign trade. Shipments of logs, hewn timbers, barrel staves, lumber for construction, and the finer woods for furniture and special uses have continued in ever-increasing amounts, and have gone to every country. Some countries, as those of western Europe, have looked to the United States to help supplement their own inadequate supplies of softwoods for construction or to

TABLE 275.—LUMBER SAWED IN THE UNITED STATES

Region	Lumber Sawed in					
	1899		1909		1919	
	Million bd. ft.	Per cent of total cut	Million bd. ft.	Per cent of total cut	Million bd. ft.	Per cent of total cut
New England	2,204	6	2,668	6	1,418	4
Middle Atlantic	3,505	10	2,529	5	1,166	3
Lake	8,760	25	5,476	12	2,692	8
Central	6,000	17	5,623	13	3,038	9
South Atlantic and East Gulf	5,906	17	9,412	21	7,204	21
Lower Mississippi	5,200	15	10,561	24	8,874	26
Rocky Mountain	604	2	1,335	3	1,362	4
Pacific Coast	2,901	8	6,905	16	8,798	25
Total	35,080	100	44,509	100	34,552	100

furnish special woods which they did not have. Others, as some of the tropical American countries, have obtained almost their whole supply of building timber from the United States and Canada. The greatest amount of lumber exported in any one year was 3,452,641,000 board feet, in 1913, which was about 8 per cent of the total amount cut that year in the United States. The value of exports of wood and wood manufactures in 1913 was approximately $115,000,000, and was exceeded by

TABLE 276.—PRINCIPAL KINDS OF LUMBER CUT IN THE UNITED STATES

Kind	1899		1909		1919	
	Million bd. ft.	Per cent of soft-wood cut	Million bd. ft.	Per cent of soft-wood cut	Million bd. ft.	Per cent of soft-wood cut
Softwoods:						
Southern yellow pine	9,658	37	16,277	48	13,063	48
Douglas fir	1,736	7	4,856	14	5,902	21
Western yellow pine	945	4	1,500	4	1,755	6
Hemlock	3,421	13	3,051	9	1,755	6
White pine	7,742	29	3,900	12	1,724	6
Spruce	1,448	5	1,749	5	980	4
Cypress	496	2	956	3	656	2
Redwood	360	1	522	2	410	1
Larch	51	.....	421	1	388	1
Cedar	233	1	346	1	332	1
Firs (*Abies*)	[1]	.....	198	1	291	1
Total softwoods	26,459	100	33,898	100	27,409	100
Hardwoods:						
Oak	4,438	51	4,414	42	2,708	38
Maple	633	7	1,107	10	857	12
Red gum	285	3	707	7	851	12
Chestnut	207	2	664	6	546	8
Birch	133	2	452	4	375	5
Beech	[1]	.....	511	5	359	5
Yellow poplar	1,115	13	859	8	329	5
Elm	457	5	347	3	194	3
Basswood	308	4	399	4	184	3
Hickory	97	1	334	3	170	2
Ash	269	3	291	3	155	2
Cottonwood	415	5	266	2	144	2
Total hardwoods	8,625	100	10,611	100	7,143	100

[1]Not recorded separately.

only six other products. Lumber exports began to decline in 1914, and in 1920 totaled only a little over 2,000,000,000 board feet. The unit values had risen to such an extent, however, that the wood and its manufactures exported in 1920 were valued at $186,000,000. In both cases the values given include wood pulp but not paper. Paper and articles made from paper were exported to the value of $21,000,000 in 1913, and $89,000,000 in 1920.

The United Kingdom has long been the best customer for American lumber, except Canada, much of whose importation from the United States has been the result of local interchange along the border, offset to a considerable extent by exportation in the other direction. The American countries south of the United States, particularly Cuba, Mexico, and Argentina, also buy very large quantities. Prior to 1914 Australia, New Zealand, China, Italy, Germany, and France were the other most important lumber customers of the United States.

The average total exports of hewn, sawed, and round timber, ties, shingles, staves, and sawed lumber during the periods 1910-1914 and 1915-1919, with their principal destinations, are given in Table 277.

TABLE 277.—EXPORTS OF LUMBER AND TIMBER FROM THE UNITED STATES.

Country of destination	Average, 1910–1914		Average, 1915–1919	
	1,000 bd. ft.	Per cent of total	1,000 bd. ft	Per cent of total
Canada	634,439	21.3	296,559	19.9
United Kingdom	480,399	16.1	331,211	22.2
South America	441,662	14.8	153,573	10.3
Australia and New Zealand	217,328	7.3	106,054	7.1
West Indies	181,316	6.1	240,902	16.1
Mexico	144,380	4.9	95,398	6.4
Germany	117,547	3.9	1,066	0.1
Italy	100,975	3.4	34,862	2.3
China	86,263	2.9	31,560	2.1
Central America	84,091	2.8	47,286	3.2
France	72,857	2.5	37,987	2.5
Japan and Chosen	14,797	0.5	22,750	1.5
Europe, other than above	303,738	10.2	49,150	3.3
Africa	45,733	1.5	23,387	1.6
All other countries	53,855	1.8	21,016	1.4
Total	2,979,382	100.0	1,492,761	100.0

The exports during the war undoubtedly were abnormally low, and probably are yet; therefore the pre-war figures give a better idea of normal conditions. The total amount of wood sent out of the country was somewhat greater than the above figures indicate, as they do not include many rough or semi-manufactured products such as wood pulp, trimming, molding, sash and doors, box shooks, firewood, and charcoal. Table 278 gives in detail the pre-war exports, exclusive of fully manufactured products such as furniture, vehicles, paper, and other articles made wholly or mostly of wood.

While it is impossible to give the exact quantities of some of these products, an approximate figure can be derived by comparing the values with those for other products or certain kinds of wood for which the statistics give both quantities and values. If these be added to the quantities given in board feet, and all converted into terms of standing timber, the result is approximately 754,000,000 cubic feet for the total average export just before the war.

Imports.—The imports of wood into the United States are of two general classes: cabinet woods, including such species as mahogany, cedar, Circassian walnut, oak, ebony, boxwood, lignum vitae and various other tropical woods; and common lumber and timber, principally softwoods, for construction, wood pulp, and general use. Closely related to the first group are woods used for dyes and tanning, such as logwood and quebracho. While most of the cabinet woods are imported in the form of logs, bolts, or hewn timbers, a relatively small amount comes in as sawed lumber. Before the war, imports of unmanufactured cedar and mahogany were increasing, from an average of a little more than 40,000,000 board feet during the period of 1900-1904 to over 70,000,000 feet in 1910-1914. These two comprised about 80 per cent of the rough cabinet woods, and the other 20 per cent was divided among a large number of species, of which the most important was walnut. About two-thirds of the cedar and mahogany came from Mexico, Central America, and the West Indies, and a large part of the remainder from Africa. South America's share is increasing. Of the dyewoods, logwood comes mostly from Haiti, with smaller amounts from Jamaica, Santo Domingo, Mexico, Central America, and the West Indies. Fustic is from the same general region, with Mexico the principal source. Argentina furnishes practically all of the quebracho wood for tanning, as well as thousands of tons of quebracho extract.

Importation of pulp wood has increased rapidly during the last two decades. In 1907 only 650,000 cords was imported, while in 1920 the quantity was 1,241,000 cords. Practically all of it comes from Canada. The volume of wood pulp imported has grown much more rapidly, from about 80,000 long tons in 1900 to more than 800,000 long

TABLE 278.—PRE-WAR EXPORTS, UNITED STATES

Kind of product	Quantity or value
Logs and round timbers:	*1,000 bd. ft.*
Walnut[1]	9,826
Hickory[1]	8,231
Oak[1]	3,350
All other[1]	135,729
Timbers:	
Hewn	33,291
Sawed	449,333
Lumber: Sawed boards, planks, and deals—total	2,195,475
Longleaf yellow pine[1]	853,445
Shortleaf yellow pine[1]	37,325
Other yellow pine[2]	177,827
White pine[2]	46,581
Fir[1]	658,298
Redwood[2]	59,529
Spruce[1]	18,182
Cypress[2]	14,443
Oak[1]	247,143
Gum[1]	71,550
Poplar[1]	30,539
All other species[2]	190,603
Joists and scantlings	25,585
Railroad ties[2] (5,269,858 ties)	158,096
Total (1910–1914 basis)	3,018,916
Shingles (thousands)	98,840
Staves (pieces)	69,245,625
Wood pulp (short tons)	12,369
	value
Heading	$321,684
Box shooks[1] (11,588,286 shooks)	$1,235,804
Other shooks (1,137,420 shooks)	$2,156,227
All other lumber [2]	$3,057,823
Sash, doors, and blinds	$1,086,267
Hogsheads and barrels [1]	$540,471
Trimming and molding	$807,907
Charcoal	$50,676
Firewood	$284,354

[1]Average for 1912–1914.

[2]Average for 1913–1914. All other averages for 1910–1914.

tons in 1920. From 1900 to 1908 about three-fourths of it came from Canada and most of the remainder from Germany, Sweden, Norway, and Finland. From 1909 to 1915 Canada supplied only between 40 and 50 per cent, but in 1916 her share again reached 70 per cent of the total, and in 1918 she furnished almost the entire amount.

Table 279 gives the amounts of wood pulp imported from different countries in 1920.

TABLE 279.—IMPORTS OF WOOD PULP, UNITED STATES

Country of origin	Ground-wood	Sulphate	Sulphite	Total	Per cent
	long tons	*long tons*	*long tons*	*long tons*	
Canada	176,637	114,175	293,722	584,534	72.0
Sweden	6,991	52,012	80,745	139,748	17.0
Finland	11,442	7,762	18,831	38,035	5.0
Norway	10,165	3,363	17,062	30,590	4.0
Germany	.....	531	7,393	7,924	1.0
United Kingdom	2,347	.....	847	3,194	0.4
Japan	.....	249	2,844	3,093	0.4
All others	586	456	1,034	2,070	0.2
Total	208,168	178,548	422,478	809,194	100.0

Imports of common timber and lumber came almost entirely from Canada until 1912, when Mexico began to export yellow pine. Japan is the only other country to send much sawed lumber to the United States, except for a few million board feet of cabinet woods from the Philippines and the West Indies. Canada still supplies more than 95 per cent of the total quantity, which has doubled since 1900. During the war the United States imported more wood than she exported. In 1920 about 1,730,000,000 board feet of sawed lumber, round, hewn, and sawed timbers, railroad ties, lath, and shingles, was imported, besides 75,000,000 board feet of rough and 12,000,000 board feet of sawed cabinet woods.

The total average annual imports of wood, not including finished products, like furniture and paper, but including pulp, are given in Table 280 for the five-year period just preceding the war (1910-1914).

The total volume of timber represented by all of these products is approximately 558,000,000 cubic feet. The total value of wood and wood manufactures imported in 1913 was $63,000,000, while in 1920 it was $212,000,000. While these figures indicate a greater volume of exports than of imports, the difference is only an insignificant fraction of

the total consumption. Moreover, exports and imports are much closer together now than they were before the war.

Domestic Consumption.—The United States uses more wood than any other country in the world, and more than three-fourths as much as all other countries combined. It uses half of all the sawtimber consumed by the world, and one-third of all the fuel wood. The average annual consumption is approximately 24,100,000,000 cubic feet, or 228 cubic feet per capita, which is considerably below the per capita consumption of several other countries, particularly Canada and Finland. About 10,548,000,000 cubic feet is firewood (including a small amount of

TABLE 280.—IMPORTS OF WOOD, UNITED STATES (1910–1914)

Kind of product	Quantity
Unmanufactured:	*1,000 bd. ft.*
Cabinet woods:	
Cedar	17,776
Mahogany	53,684
Logs and round timber	159,243
Manufactured:	
Sawed lumber:	
Boards, planks, deals	962,396
Sawed cabinet woods	8,580
Total	1,201,679
Lath (pieces)	664,750,000
Shingles (pieces)	675,075,000
Fence posts (pieces)	356,678
Hewn timber (cubic feet)	389,015
Round timber for spars and wharves (cubic feet)[1]	75,226
Clapboards (boards)	5,942,000
Firewood (cords)	24,380
Pulpwood (cords)	976,296
Dyewoods:	
Logwood (long tons)	34,874
Fustic (long tons)	5,041
Other dyewoods (long tons)	386
Quebracho wood (long tons)	78,345
Handle and shingle bolts (cords)	11,909
Pickets and palings (pieces)	39,207,000
Wood pulp:	
Mechanical (pounds)	399,470,051
Chemical (pounds)	657,351,415
Wood flour (pounds)	9,413,695

[1] Average for 1911–1913.

TABLE 280.—IMPORTS OF WOOD, UNITED STATES (1910–1914)—*Continued*

Articles for which the statistics give values but not quantities

Kind of product	Value
Unmanufactured cabinet woods other than above	$1,066,196
Ship timber	186,069
Sticks for canes, etc., in the rough	177,336
Sticks for canes, etc., manufactured	55,205
Hop and hoop poles	3,452
Gunstock flitch	16,589
Hubs and last, oar, and heading blocks	19,972
Paving, ties, posts, poles	827,458
Shooks	19,024
Staves	35,477
Barrels (slack) and boxes	376,347
Barrels, casks, and hogsheads (tight)	2,400
Veneers	11,712
Charcoal	27,498

acid and extract wood) and 13,556,000,000 cubic feet is saw timber or other timber for industrial use. The consumption for various purposes is approximately the same as the amounts given in Table 274.

The per capita consumption of wood in the United States rose steadily until 1906, since when it has declined. Among the causes of the decreasing consumption are the introduction of substitutes and greater economy in the use of wood, both of which have been greatly stimulated by the growing scarcity and mounting prices of timber. A third factor which has held consumption lower than it would otherwise have gone was the World War and economic conditions resulting from it.

While data as to changes in rate of consumption of wood in all forms are not available, those for sawed lumber give a good idea of the situation. The average number of board feet of lumber used per capita at different periods was approximately as follows:

Year	*Bd. ft. per capita*	*Year*	*Bd. ft. per capita*
1859	255	1906	515
1869	340	1909	475
1879	360	1913	430
1889	430	1919	325
1899	450		

The Lumber and Wood-Using Industries.—The industries grouped by the United States census under the heading "Lumber and its Remanufactures" rank third among all the manufacturing industries of the

country in number of employees and wages paid, second in primary horsepower consumed, and fifth in capital invested and value of the product. Several other industries which are not grouped under this heading are also equally dependent on the forest for their raw materials. Among them are the pulp and paper, naval stores, wood distillation, and wooden shipbuilding industries, and the manufacture of pianos and organs. Many other products, such as railway cars, wagons and carriages, automobiles, aeroplanes, phonographs, and toys, require large amounts of wood.

In 1919 industries whose raw materials were wholly or in very large part derived from the forests employed 1,200,000 wage earners, paid wages amounting to $1,220,000,000, and turned out finished products valued at $4,900,000,000. These industries were capitalized at $4,260,000,000, and utilized 5,600,000 primary horsepower. Comparative statistics for 1914 and 1919 of the more important ones are given in Table 281.

The lumber industry has migrated as timber supplies in one region after another became depleted, and as new ones were opened up. Starting in New England, the center of production passed to New York and Pennsylvania, then to the Lake States pine forests, where it remained for 30 years or more, and then to the southern pine belt. In that region it gradually worked to the westward, clearing out the best of the virgin timber, and leaving the poorer or more scattered stands and such second growth as accidentally came up to be cut by the small mills. The peak of production of southern pine has now been passed, and the larger units of the industry are gradually becoming concentrated in the Pacific coast region. There the tendency is toward mills of still greater capacity, with animal and hand labor superseded as far as possible by steam and electric logging machinery. This tendency is likely to continue until all of the more extensive tracts of choice timber are developed. As these tracts are cut out and the remaining timber becomes more scattered, a larger number of small mills, established on a more permanent footing, will take the place of the existing large mills whose operation must necessarily be on a more or less temporary basis.

There were 29,534 sawmills in operation during 1919, as compared with 46,584 mills in 1909. The average output per mill increased from 955,000 to 1,170,000 board feet during the decade. Table 282 classifies the mills according to output.

About 1910 the average consumption of lumber by secondary industries making various products wholly or partly of wood was 11,150,000,000 board feet, not counting the amount used for sash, doors, blinds, flooring, siding, and other planing mill products, most of which go into building construction. The largest portion of this, amounting to 4,600,000,000

board feet, was used for boxes and crates. Others of the most important products included railway cars (1,260,000,000 feet), furniture (1,235,000,000 feet), vehicles (740,000,000 feet), agricultural implements (320,000,000 feet), handles (280,000,000 feet), and musical instruments (260,000,000 feet).

Forestry Movement and Legislation.—Even in early colonial times certain restrictions were imposed on the cutting of timber from public

TABLE 281.—INDUSTRIES USING WOOD AS RAW MATERIAL

Industry	Year	Number of establishments	Wage earners employed	Capital invested	Value of product
			Thousands	*Millions*	*Millions*
Lumber, timber, and planing mill products..	1914	33,090	576	$1,184	$1,024
	1919	31,428	568	1,720	1,888
Paper and wood pulp....	1914	718	88	535	332
	1919	729	114	906	788
Furniture, other than metal.....	1914	3,019	115	233	231
	1919	2,997	125	367	501
Manufactures of paper and pulp.....	1914	1,783	81	164	195
	1919	2,007	97	306	487
Pianos, organs, and phonographs.....	1914	496	47	165	116
	1919	538	65	260	308
Wooden boxes.....	1914	1,412	44	72	95
	1919	1,329	48	126	191
Wooden shipbuilding...	1914	1,068	11	23	22
	1919	913	43	121	166
Turpentine and rosin....	1914	1,394	35	21	21
	1919	1,191	28	34	53
Wagons, carriages, sleds, and wheelbarrows.....	1914	4,714	48	161	119
	1919	2,400	25	95	118
Cooperage.....	1914	1,259	17	37	50
	1919	1,099	13	49	88
Wood distillation.....	1914	95	3	18	10
	1919	115	5	42	33

lands in the northeast. Most of these, however, were rather for the purpose of protecting the property of the crown than for conserving the timber supply. In 1799 Congress appropriated money for purchasing timber reserves to provide ship timbers for the navy, and in 1817 certain islands along the coast of the Gulf of Mexico were set aside as naval reserves for the growing of live oak timbers.

Not until about 1850, however, when supplies of timber easily accessible to the more thickly settled portions of the country began to be scarce, was any serious thought given to the possibility of future exhaustion of the forests. As a result of years of agitation and discussion, many of the individual States passed laws between 1868 and 1875 to encourage tree planting, by granting bounties or certain exemptions from taxation. In 1873 Congress passed the "Timber Culture Act," providing grants of free public land in the treeless western States, as rewards for the planting of certain areas to timber. During the same period and later most of the States enacted laws providing penalties for setting forest fires. None of these laws were especially effective. In 1876 an agency was established in the Federal Department of Agriculture to investigate forest conditions and disseminate information on the subject. This later developed into the Division and then the Bureau of Forestry, which eventually became the Forest Service.

An Act of Congress in 1891 marked the beginning of the policy of setting aside public forests, by empowering the President to reserve from further alienation public lands bearing forests. During the next few years about 17,500,000 acres was so reserved. In 1897, as a result of recommendations made by the National Academy of Sciences and

TABLE 282.—CLASSIFICATION OF SAWMILLS, UNITED STATES

Mills cutting	In 1909		In 1919	
	Number of mills	Total production	Number of mills	Total production
		Million bd. ft.		*Million bd. ft.*
10,000,000 feet and over.....	888	19,126	792	18,814
5,000,000 to 10,000,000 feet..	783	5,291	503	3,545
1,000,000 to 5,000,000 feet.	5,443	10,068	3,211	5,972
500,000 to 1,000,000 feet.....	6,468	4,316	3,977	2,663
50,000 to 500,000 feet.....	28,459	5,583	18,396	3,474
Less than 50,000 feet..	4,543	125	2,655	84
Total.....	46,584	44,509	29,534	34,552

the President's action in reserving 20,000,000 acres at one time, Congress provided for the administration and protection of the forest reserves, and the sale of timber from them under certain restrictions. By the same law, the purpose of the reserves was declared to be "to improve and protect the forest . . . or for the purpose of securing favorable conditions of waterflows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States." At that time the reserves were administered by the Department of the Interior, but in 1905 their management was transferred to the Department of Agriculture, and in 1907 they were designated "National Forests." The area of reserves was gradually extended until in 1922 they included 136,000,000 acres of public land in continental United States, besides 20,000,000 acres in Alaska and a small area in Porto Rico.

In 1911 the national forest policy was further extended by legislation providing for the purchase of forest lands on the watersheds of navigable streams, and for cooperation with the States in forest fire protection. Under this act nearly 2,000,000 acres has been purchased.

Meanwhile several of the States were developing forest policies and building up organizations to promote forestry and conserve their resources. In 1883 New York took steps to reserve the remaining State lands and such as might later revert for non-payment of taxes, and in 1897 began the purchase of private forest lands to round out the State reserve. This reserve so far has been used rather as a park than for timber production. Pennsylvania organized a forestry department in 1895, and at the same time undertook the purchase of land for State forests, which are to be managed for growing timber. Several of the other States, especially in the northeast and northwest, have followed the example of these two and set aside or acquired lands for public forests. Thirty-three States in all now have forestry departments, and 24 cooperate with the Federal government in forest fire protection.

Altogether just about half of the forest land in the United States now receives some degree of fire protection. This includes the national forests, the Indian reservation forests, the national parks, the State forests, and about 150,000,000 acres of private forests. Approximately 219 million acres of private forests (1921) and a small area of forest on the unreserved public domain are utterly without protection. Not all of the protected land can be considered as dedicated to continuous forest production, however. Only the national forests, some of the Indian and State forests, and an exceedingly small portion of the private forests are managed with any thought of producing more timber after the present stand has been removed. Even with most of these, such management is rather a policy for future treatment than a present practice,

because only a small fraction of the total area is actually under exploitation.

Secondary Products of the Forests.—The most important products other than timber obtained from the forests of the United States are turpentine and rosin ("naval stores") and tanning materials. Wood pulp and products of wood distillation, though strictly speaking they are taken from the forest in the form of timber, may also be classed with secondary products. The production of edible materials, particularly nuts and maple sugar, is of considerable importance, and minor industries are based on the extraction of dyes, gums, medicinal substances, and essential oils.

The Pulp Industry.—The wood pulp industry in the United States, as in other countries, depends for its raw material chiefly on the forests of spruce, hemlock, balsam fir, and aspen. While the amount of yellow pine used is gradually increasing, it still forms only a small part of the total. The total consumption of pulpwood rose from 1,986,000 cords in 1899 to 4,001,000 cords in 1909 and 6,114,000 cords in 1920. The proportions of the various kinds of wood used in 1920 were: spruce 57 per cent, hemlock 15 per cent, balsam and white fir 6 per cent, poplar 6 per cent, yellow pine and jack pine 6 per cent, and all others 10 per cent. The total output of wood pulp increased from 1,179,525 short tons in 1899 to 2,495,523 tons in 1909 and 3,821,704 tons in 1920. In the latter year 1,583,914 tons was ground wood pulp, and 1,585,834 tons, 463,305 tons, and 188,651 tons were produced by the sulphite, soda, and sulphate processes, respectively.

The principal centers of the industry are in the northern forest region of New England, New York, the Lake States, and the Appalachian Mountains. The principal producing States in 1920 are given in Table 283.

In the Northeast the industry has been developed beyond the capacity of the forests to keep it supplied with wood, and for this reason approximately 1,000,000 cords of wood is imported every year from Canada. Imports reached the highest point, 1,370,000 cords, in 1918. In 1920 the amount was 1,241,000 cords. The imports would undoubtedly be considerably greater were it not for the embargo on exports of unmanufactured timber from the crown lands in certain Canadian provinces. While the industry is overdeveloped in the East, it is greatly underdeveloped in the Northwest, where there are abundant supplies of excellent pulp woods. It is in the Pacific coast States and Alaska that the principal future expansion in the production of pulp may be looked for.

Great as the domestic production is, imports of wood pulp are steadily increasing. During the 12 years, 1909-1920, the average import was 600,000 short tons, and in 1920 it amounted to 906,000 tons. Export of

pulp during the same period averaged 22,000 tons, and in 1920 it was 32,000 tons. Import of newsprint paper in 1920 was 730,000 tons and export only 46,000 tons; exports of other printing paper and wrapping paper, however, which were respectively 47,845 tons and 30,632 tons, exceeded imports of similar commodities, amounting to 2,170 tons and 2,471 tons, respectively.

The per capita consumption of paper and other wood pulp products in the United States rose from an insignificant amount in 1875 to approximately 100 pounds in 1920, and so far as can be seen will probably continue to rise.

The Naval Stores Industry.—The early settlers along the Atlantic Coast secured tar and pitch for caulking their boats, as well as turpentine and rosin, from the various species of yellow pines which were so abundant. In New England and New Jersey pitch pine (*Pinus rigida*) was the source of naval stores, while farther south loblolly and especially longleaf and slash pines were utilized. As the demand for these products declined with wooden shipbuilding, the requirements of many other industries increased. Large quantities of turpentine and rosin are used in the manufacture of paint, oil, varnish, soap, paper, oilcloth, linoleum, rubber, print cloth, and other articles.

The industry early became centralized in North and South Carolina, which led in output for many years. In 1879 they produced nearly 11,000,000 gallons of turpentine and 1,000,000 barrels (280 pounds gross each) of rosin, out of the total of 18,000,000 gallons and 1,540,000 barrels

TABLE 283.—PRODUCTION OF WOOD PULP IN THE UNITED STATES, 1920

State	Number of establishments	Pulpwood consumed	Wood pulp produced
		cords	*short tons*
Maine	35	1,389,495	942,730
New York	78	1,130,505	830,045
Wisconsin	45	964,781	548,528
Pennsylvania	14	490,784	238,013
New Hampshire	11	403,530	239,634
Minnesota	6	254,193	170,216
Michigan	12	243,632	132,776
Oregon, Washington, California	11	334,193	244,342
West Virginia, Virginia, North Carolina	13	417,844	186,914
Vermont, Massachusetts	13	172,814	131,353
All others	15	312,291	157,153
Total	253	6,114,072	3,821,704

made in the entire country. As the longleaf pine forests of the Carolinas became exhausted, the center of production shifted to Georgia, and twenty years later (about 1900) to Florida, which still holds the lead. At about the same time Alabama, Mississippi, and Louisiana began to produce considerable quantities of naval stores. Texas did not start until 1909, and did not begin to be an important producer until 1914. It was the only State to show an increased production between 1914 and 1919. The total production of naval stores reached its peak in 1899, with an output of 37,733,000 gallons of turpentine and 4,348,000 barrels of rosin. Since then it has steadily declined to less than half of those amounts in 1919. The production by States for various years between 1879 and 1919 is shown in Table 284.

TABLE 284.—PRODUCTION OF TURPENTINE AND ROSIN IN THE UNITED STATES[1]

Spirits of turpentine—Thousands of gallons

State	1879	1889	1899	1904	1909	1914	1919
Alabama	2,005	180[2]	3,704	3,108	2,840	2,722	2,037
Florida	1,036	387	11,839	12,873	13,810	12,363	6,992
Georgia	3,152	9,667	15,290	9,542	8,057	6,228	3,997
Louisiana	250	.....	215	245	1,231	2,252	1,885
Mississippi	250	616	3,213	3,160	1,589	2,385	1,750
North Carolina	6,279	3,717	1,994	994	781	183	67
South Carolina	4,593	3,105	1,478	764	460	201	58
Texas	.....	.....	.....	.....	221	647	906
Total	18,015	17,672	37,733	30,687	28,989	26,981	17,694

Rosin—Thousands of barrels (280 pounds gross)

Alabama	158	19[2]	415	360	310	295	216
Florida	68	31	1,310	1,446	1,556	1,310	869
Georgia	278	671	1,614	1,105	904	621	419
Louisiana	20	.....	24	30	139	269	202
Mississippi	20	60	410	363	193	275	207
North Carolina	664	365	371	116	83	24	7
South Carolina	334	283	204	88	51	16	6
Texas	.....	.....	.....	.....	28	75	107
Total	1,542	1,429	4,348	3,508	3,264	2,885	2,033

[1] These figures do not include turpentine and rosin produced in wood distillation plants.

[2] Includes production of Missouri.

The naval stores industry in the United States has been carried on in an extremely wasteful manner, and this, together with lumbering and the fires which accompanied it, has gradually reduced the area of yellow pine forests on which it depends, with the result indicated in Table 284. The number of establishments decreased in 10 years (1909 to 1919) from 1,585 to 1,191, and the number of wage earners decreased from 39,511 to 28,067. If the industry continues to decline at this rate, it will be only a few years before production is inadequate even to supply domestic requirements, instead of providing a large surplus for export.

Exports of turpentine and rosin in 1919 amounted to 10,672,102 gallons and 1,209,627 barrels respectively, as compared with the pre-war average (1910–14) of 15,989,000 gallons and 2,406,000 barrels.

The yellow pine forests are ample in extent, however, if properly handled for the production of continuous timber crops, to support permanently a naval stores industry with several times the present output. Moreover, experiments have shown that western yellow pine is capable of producing considerable quantities of resin, though its yields are smaller than those of southern pine.

Tanning Materials.—The tanning industry developed early in the New England States, and was largely concentrated there and in New York for many years. The tanneries were located where raw materials—oak bark, hemlock bark, and chestnut wood, were abundant, but as the supplies became depleted in the northeast the center of production shifted to the southward and westward. Now that extracts are so extensively used in place of wood and bark, the cost of transporting tanning materials is less important than the cost of marketing the leather, and the tanneries are no longer located primarily with reference to supplies of raw materials.

The consumption of tanning materials in 1909 and 1919 is given in Table 285.

These figures show very strikingly the trend toward greater use of extracts and diminishing use of wood and bark.

Of the above substances only hemlock, chestnut, oak, spruce, and larch and a small part of the sumac were domestic products, and considerable quantities even of oak, hemlock, and chestnut were imported. Much of the imported tanning material comes in rough form, and is made into extract in the United States. The principal raw products consumed in the manufacture of tanning extracts in 1919 are given in Table 286.

An important domestic source of tannin, which has not yet been exploited to any extent, is the western hemlock of the Pacific coast region and Alaska, supplies of which are large.

Wood Distillation.—While charcoal had been made in pits or kilns

since the first settlement of the country, the distillation of wood for the purpose of recovering other products dates back only about 60 years. The industry has two distinct branches, hardwood and softwood distilla-

TABLE 285.—CONSUMPTION OF WOOD TANNING MATERIALS

Material	Bark, wood, and other manufactured materials		Extract	
	1909	1919	1909	1919
	short tons	*short tons*	*short tons*	*short tons*
Hemlock	698,365	284,323	5,431	13,517
Oak	324,070	261,519	19,210	28,935
Chestnut	18,527	32,526	91,409	216,060
Myrobalans	18,000	8,354	551	1,487
Divi-divi	.....	4,725	.....	6,386
Quebracho	.....	2,346	73,555	79,660
Sumac	.....	2,328	175	3,335
Mangrove	18,925	2,078	701	2,484
Logwood [1]	.....	955	.....	790
Valonia	.....	303	122	87
Gambier	.....	189	1,320	2,065
Spruce	.....	156	.....	24,031
Larch	.....	.....	.....	2,988
Other	1,023	9,328	935	15,355
Total	1,078,910	609,130	193,409	397,180

[1] Used for coloring the leather.

TABLE 286.—MATERIALS USED IN MAKING TANNING EXTRACTS, 1919

Material	Short tons
Chestnut wood	754,972
Chestnut oak bark	61,155
Hemlock bark	25,594
Black oak bark [1]	10,353
Sumac leaves [1]	5,504
Others [2]	30,537

[1] Used to some extent also for dyes.

[2] Quebracho, larch, spruce, tanbark oak, wattle bark, divi-divi, gambier, myrobalans, and a few dye materials.

tion. Hardwoods yield wood alcohol, acetates, tar, oils, charcoal, and derived products such as formaldehyde, acetone, and ketone, while the principal products derived from softwoods are rosin, turpentine, tar, tar oils, creosote, and charcoal.

While the quantity of hardwoods used is now about four times that of softwoods, the proportion of the latter is steadily increasing. Total consumption increased from 491,000 cords (including only 3,000 cords of softwood) in 1899 to 1,442,000 cords (256,000 cords of softwood) in 1919.

Table 287 gives the principal products of the industry in 1919.

TABLE 287.—PRINCIPAL PRODUCTS OF WOOD DISTILLATION, 1919

Hardwood distillation:	
Crude methyl alcohol	9,103,996 gallons
Acetate of lime	168,956,432 pounds
Charcoal	46,354,342 bushels[1]
Tar	552,124 gallons
Tar oil	222,398 gallons
Wood creosote	945,605 pounds
Softwood distillation:	
Rosin	234,030 barrels[2]
Turpentine	1,534,333 gallons
Tar	2,125,757 gallons
Tar oils	581,042 gallons
Charcoal	1,702,103 bushels
Wood creosote	207,050 pounds

[1] One bushel = 20 lbs. [2] One barrel = 280 lbs.

The hardwood industry is mostly confined to the northern hardwood region, where the birch-beech-maple forest occurs. More than half of all the wood distilled in 1919 was used in Michigan, about one-fourth in Pennsylvania, and smaller amounts in New York, Wisconsin, and several other States. The softwood industry is practically confined to the longleaf pine region. Georgia leads with two-fifths of the total consumption, followed by Florida with one-third, Alabama with one-sixth, and Louisiana and several other States with less amounts.

Outlook for the Future.—It is obvious that the present situation cannot continue indefinitely, with production so much in excess of growth and no provision whatever for subsequent timber crops on the greater part of the cut-over lands. More adequate measures must be adopted to increase the amount of growing timber, the rate of consumption must be cut down to a small fraction of the present rate, or the United States will have to import enormous amounts of wood.

It is probable that all three things will happen in some degree. The surplus of exports over imports has been steadily dwindling for several years, and is likely to give way to a surplus of imports within a very

short period. Imports of softwoods will come from Canada, with small amounts from Central America and Mexico, while hardwoods in ever increasing quantity will be brought from tropical America, Africa, and Asia. There are not adequate supplies of softwoods, however, sufficiently easy of access for the United States to be able to count for very long on imports to supply her requirements.

A shortage of construction timber, evidenced by steadily mounting prices and resulting in increasing use of other materials in place of wood, will consequently develop gradually. The per capita consumption of lumber and other forms of sawtimber will decline, and as firewood becomes harder to get, it too will be replaced by other materials. Yet it is hardly likely that the per capita consumption of lumber will fall much below 200 board feet per annum (less than two-thirds of the present figure) within the next 50 years, nor that total consumption of all forms of wood will fall below about 150 to 175 cubic feet per capita. The increase in population will compensate for the fall in rate per capita, with the result that the total requirements for the country will tend to remain stationary or even to increase, with a somewhat larger proportion of sawtimber and less firewood.

Meanwhile the domestic forests will gradually be brought into a state of greater productivity, even though the total area may be reduced by some 50,000,000 acres which may be cleared for agriculture. The clearing is likely to be largely at the expense of the hardwood forests, while the area under conifers may lose but little, and may even be increased slightly by planting. There will be a tendency for a large part of the more mountainous forest lands, as well as those which are now unproductive as a result of devastation, to come into public ownership, either by the Nation or by individual States, and at the same time the more productive or accessible forests, particularly in regions where the proportion of forest land is high, will tend to gravitate into the ownership of corporations representing the industries which require large quantities of wood. Timber raising as a business by itself probably never will be undertaken by private owners to the extent that it has been in Europe. Most of the forest not owned by the public or by the wood-using industries will consist of small units owned by farmers and operated as part of their farms, to supply their own needs and a little for the general market.

Even reduced somewhat in area, the remaining forest land, if under fairly careful management, will be capable of producing enough wood to meet the country's needs. As these needs will be largely for timber of fair size and quality rather than firewood, however, it will require several decades of rather intensive management to bring the annual increment up to the required point.

Principal Kinds of Timber.—The most important commercial woods of the United States are listed below. Many others have limited local or special uses, or are of minor importance.

TABLE 288.—MOST IMPORTANT COMMERCIAL WOODS, UNITED STATES

Ash—White ash (*Fraxinus americana*) has hard, strong, tough, elastic wood, weighing 42 pounds per cubic foot, used for handles, vehicles, agricultural implements, furniture, and interior finish. Eastern forests.

Black ash (*F. nigra*) has lighter, weaker wood, which is darker in color, and used somewhat similarly, and especially for interior finish and woodenware. Northeastern forest.

Oregon ash (*F. oregona*) has wood resembling white ash, though less strong. Northwestern forest.

Aspen (*Populus tremuloides*) has light, soft, perishable wood weighing 27 pounds per cubic foot. It is used for paper pulp, excelsior, and other purposes. Northeastern and central Rocky Mountain forests.

Basswood (*Tilia americana*) has light, soft, easily worked wood weighing 26 pounds per cubic foot, used for boxes, trunks, woodenware, excelsior, furniture, and interior work. Eastern forests.

Beech (*Fagus grandifolia*) has hard, tough, strong, reddish wood weighing 44 pounds per cubic foot. It is rather difficult to season, but polishes well, and makes excellent woodenware, brush backs, chairs, handles, and slack staves. It is one of the principal woods used by hardwood distillation plants. Northeastern forest.

Birch—Yellow birch (*Betula lutea*) has hard, strong, reddish brown wood, weighing 44 pounds per cubic foot and susceptible of a fine polish. It is made into interior finish, furniture, turned ware, spools, and vehicle parts, and much is distilled for acetate and wood alcohol. Northeastern forest.

White or paper birch (*B. papyrifera*) is lighter in color and weight (38 pounds per cubic foot) and is used similarly, but especially for spools and tooth picks.

Cedar—Incense cedar (*Libocedrus decurrens*) has soft, weak, yellowish wood, weighing 25 pounds per cubic foot, very durable in the soil, and used for ships and boats, laundry appliances, planing mill products, and posts. California.

Port Orford cedar (*Chamaecyparis lawsoniana*) has strong, fine-grained, aromatic wood, weighing 31 pounds per cubic foot and extremely durable. Used for boats, woodenware, planing mill products, and construction. Oregon.

Red cedar—eastern (*Juniperus virginiana* and *J. barbadensis*) has soft, fine-grained, extremely durable red wood, weighing 31 pounds per cubic foot. It is the best wood for lead pencils, and makes excellent chests, fence posts, and telephone poles. Southeastern forests.

Western red cedar (*Thuja plicata*) has soft, coarse-grained, brittle, but very decay-resistant, reddish-brown wood, especially adapted for shingles, siding, posts, and telephone poles. Northwestern forests.

White cedar (*Chamaecyparis thyoides* in the southeast and *Thuja occidentalis* in the northeast) has soft, rather weak, but very durable, light-brown wood, weighing 20 pounds per cubic foot. Used for posts, poles, shingles, boats, and interior construction.

Cherry—Black cherry (*Prunus serotina*) has hard, strong, fine-grained, light-red wood, weighing 36 pounds per cubic foot, susceptible of a high polish, and excellent for furniture and cabinet work. Eastern forests.

TABLE 288.—MOST IMPORTANT COMMERCIAL WOODS, UNITED STATES—*Continued*

Chestnut (*Castanea dentata*) has fairly soft, coarse-grained, reddish-brown wood, weighing 30 pounds per cubic foot. It works easily, is very durable in the soil, and is rich in tannin. Much used for caskets and coffins, furniture and interior finish, railroad ties, posts, poles, and tannin extract. Eastern forests.

Cottonwood (*Populus deltoides* and *P. heterophylla* in the east, *P. trichocarpa* in the Pacific coast region). The wood is soft, weak, and perishable, and weighs from 24 to 26 pounds per cubic foot. Used for boxes, interior construction, woodenware, furniture, and excelsior.

Cypress—Bald cypress (*Taxodium distichum*) has soft, resinous, brown wood, easy to work and very durable in exposed situations. It weighs 34 pounds per cubic foot. Excellent for shingles, siding, general construction, tanks, and interior finish. Southern coastal plain.

Douglas fir (*Pseudotsuga taxifolia*) reaches very large sizes. The wood is fairly hard, strong, and durable, weighs 34 pounds per cubic foot, and is one of the most important American construction woods. Pacific coast and Rocky Mountain forests.

Elm—White elm (*Ulmus americana*) has hard, strong, tough, reddish-brown wood, excellent for wagon hubs, hoops, and slack staves, and also used for furniture, woodenware, and boxes. Weighs 34 pounds per cubic foot. Eastern forests.

Fir—Balsam fir (*Abies balsamea*) has soft, weak, perishable wood weighing 25 pounds per cubic foot. Mostly made into paper pulp. Northeastern forests.

White fir (*A. concolor*), and grand fir (*A. grandis*), have light soft wood, weighing from 26 to 28 pounds per cubic foot, used principally for boxes, rough construction, and interior work. Western forests.

Gum—Red gum (*Liquidambar styraciflua*) has fairly soft, easily worked, reddish-brown wood which takes a fine polish and weighs about 35 pounds per cubic foot. Its most distinctive use is in the form of veneer for furniture, interior finish, boxes, and slack cooperage. Southeastern forest.

Hemlock (*Tsuga canadensis* in the northeast, *T. occidentalis* in the northwest). The eastern species is fairly light, soft, strong, and rather difficult to work. It is widely used for rough construction, boxes, and paper pulp, and its bark for tanning. The western species has harder wood, is easier to work, and is used for similar purposes. The bark is rich in tannin, but not yet utilized to any extent.

Hickory—Various species of *Hicoria* (*Carya*). The wood of the more important species is very hard, strong, tough, and elastic, weighs about 50 pounds per cubic foot, and is unsurpassed for spokes, handles, and athletic goods. Eastern forests.

Junipers (*Juniperus* spp.) are of much local importance in the southwest for fence posts, fuel and construction. Among the more important species are *J. scopulorum, J. occidentalis, J. pachyphloea* and *J. californica.*

Larch—Western larch (*Larix occidentalis*) has hard, strong, durable wood, weighing 37 pounds per cubic foot, and excellent for general construction. Northern Rocky Mountain forest.

Locust—Black locust (*Robinia pseudacacia*) has very hard, strong, durable wood, weighing about 50 pounds per cubic foot, and especially suitable for fence posts, railroad ties, tree nails, heavy wagon parts, and insulator pins and brackets. Eastern forests.

Maple—Sugar maple (*Acer saccharum*) has hard, strong, fine-grained, light-colored wood, weighing 44 pounds per cubic foot, and extensively used for flooring, furniture, shoe lasts, and wood distillation. It also yields maple sugar. Northeastern forest.

TABLE 288.—MOST IMPORTANT COMMERCIAL WOODS, UNITED STATES—*Continued*

Maple—Oregon maple (*A. macrophyllum*) has similar wood, but not so strong or heavy. Soft maple (*A. rubrum* and *A. saccharinum*) have softer, lighter wood, used for interior work, boxes, and furniture. The soft maples occur in the eastern forests.

Oak (many species of *Quercus*)—White oak (*Q. alba*) is the most important. The wood is light reddish, hard, strong, and durable, weighing 47 pounds per cubic foot. It is favored for tight cooperage, furniture, flooring, interior finish, vehicle construction, heavy construction, and railroad ties. Similar woods, usually marketed as white oak, include *Q. macrocarpa, Q. lyrata, Q. platanoides, Q. michauxii, Q. acuminata* and *Q. prinus*, in the east, and *Q. garryana* on the Pacific coast.

Red oak (*Q. rubra* or *Q. borealis*) has coarser grained reddish wood, apt to check in drying and somewhat inferior to white oak. It is used for similar purposes excepting tight cooperage. Several other eastern oak woods are similar in general appearance and are sold as red oak. Eastern forests.

Chestnut oak (*Q. prinus*) and black oak (*Q. velutina*) of the eastern forest and tanbark oak (*Q. densiflora*) of California yield tanbark.

Pines include many species of the greatest economic importance for general construction, boxes, interior finish, matches, and a large number of other uses. Among the principal kinds are: White pine (*Pinus strobus* in the northeast, *P. monticola* in the northwest), the light, soft wood of which, weighing 27 to 30 pounds per cubic foot, is one of the best for construction and boxes; sugar pine (*P. lambertiana*) of California, the wood of which resembles white pine; red or Norway pine (*P. resinosa*) with somewhat harder and heavier wood (24 pounds); western yellow pine (*P. ponderosa* and *P. jeffreyi*), with light wood (28 pounds) something like white pine, though not so strong; shortleaf pine (*P. echinata*) of the southeast, whose wood is fairly soft and not heavy (36 pounds); loblolly pine (*P. taeda*), a fast growing southeastern species with fairly hard but very perishable wood; slash pine (*P. caribaea* or *P. heterophylla*) and longleaf pine (*P. palustris*) whose resinous wood weighs over 40 pounds per cubic foot, is very hard, strong and durable, and unsurpassed for heavy construction; and lodgepole pine of the Rocky Mountains (*P. contorta* or *P. murrayana*) a comparatively small but abundant tree with soft, light wood (29 pounds). The piñon pines (*P. edulis* and others) of the southwest are of great local importance for domestic construction, posts, fuel, and food, for which their seeds are utilized.

Redwood (*Sequoia sempervirens*) has soft, light (24 pounds per cubic foot), fine-grained, red wood, very easy to work and finish, and durable in the air and the soil. Excellent for general construction, shingles, siding, wood pipe, tanks, and railroad ties. California.

Spruce—The most important are red spruce (*Picea rubra*), of the northeastern forest, Engelmann spruce (*P. engelmanni*) of the Rocky Mountains, and Sitka spruce (*P. sitchensis*) of the northwest coast region. The wood is soft, nearly white, fine-grained, and easily worked. It weighs from 24 to 26 pounds per cubic foot. Used for interior construction, boats, boxes, and woodenware.

Sycamore (*Platanus occidentalis*) has hard, fairly heavy (36 pounds), brownish wood, very difficult to split and well adapted for butchers' blocks, boxes, and woodenware. Sometimes used for interior finish. Eastern forest.

Tamarack, or eastern larch (*Larix laricina* or *L. americana*) has moderately hard, durable wood, excellent for posts, poles, and railroad ties. Northeastern forest.

TABLE 288.—MOST IMPORTANT COMMERCIAL WOODS, UNITED STATES—*Continued*

Tupelo or cotton gum (*Nyssa aquatica*) has soft, fine-grained, light wood (32 pounds per cubic foot), excellent for boxes, woodenware, rough construction, and insides of furniture. Southeastern forest.

Walnut—Black walnut (*Juglans nigra*) is one of the best American woods for furniture and cabinet work. The dark brown wood is hard, strong, very durable, and weighs 37 pounds per cubic foot. It works and finishes well. It is the best wood for gunstocks and airplane propellers. Eastern forest.

Yellow poplar (*Liriodendron tulipifera*) has light (28 pounds per cubic foot), soft, yellowish wood, very easy to work, and used for panels, interior finish, woodenware, furniture, boxes, and paper pulp. Eastern forest.

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ALASKA

Forest Area.—The total area of Alaska is 378,165,760 acres. The total forest area has been estimated at from 70 to 150 million acres. This forms about 19 to 40 per cent of the land area. With a population of 55,000, the per capita forest area is between 1,273 to 2,730 acres. The present forest area may be considered as the original area of forest, although the actual productive forest area, because of uncontrolled fires in the interior forest region, must have been reduced since settlement.

Character of the Forests.—The forests of Alaska occur in two distinct regions. One-fifth lies within the Pacific mountain system and four-fifths within the central plateau region of the interior. The timber in the interior is more of a woodland type made up of inferior species, and of sizes valuable chiefly for fuel and minor purposes. The coastal or the Pacific mountain forest is almost wholly coniferous. It occurs in

the form of a narrow strip along the shore, extending back from tide water an average of one mile. The two principal species which make up the coastal forest are western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*). The first forms about 75 per cent of the stand and the latter about 15 per cent. Western red cedar (*Thuja plicata*), yellow cedar (*Chamaecyparis nootkatensis*), a little cottonwood, birch, lodgepole pine, and white fir, form the remaining 10 per cent. The interior forest is made up of spruce, white birch, and cottonwood, and is very similar in character to the northern Arctic forests of Canada, of which it is an extension. It has been explored but little, and its extent and stand are therefore very inadequately known.

Ownership.—Of the total forested area 20,579,740 acres, or almost the entire coastal forest, is in the two National Forests—the Chugach and the Tongass—under the administration of the Department of Agriculture. The remaining 50 to 130 million acres, largely the interior forest, is on the unreserved public domain under the administration of the General Land Office. Probably not over 5,000 acres are private forest lands.

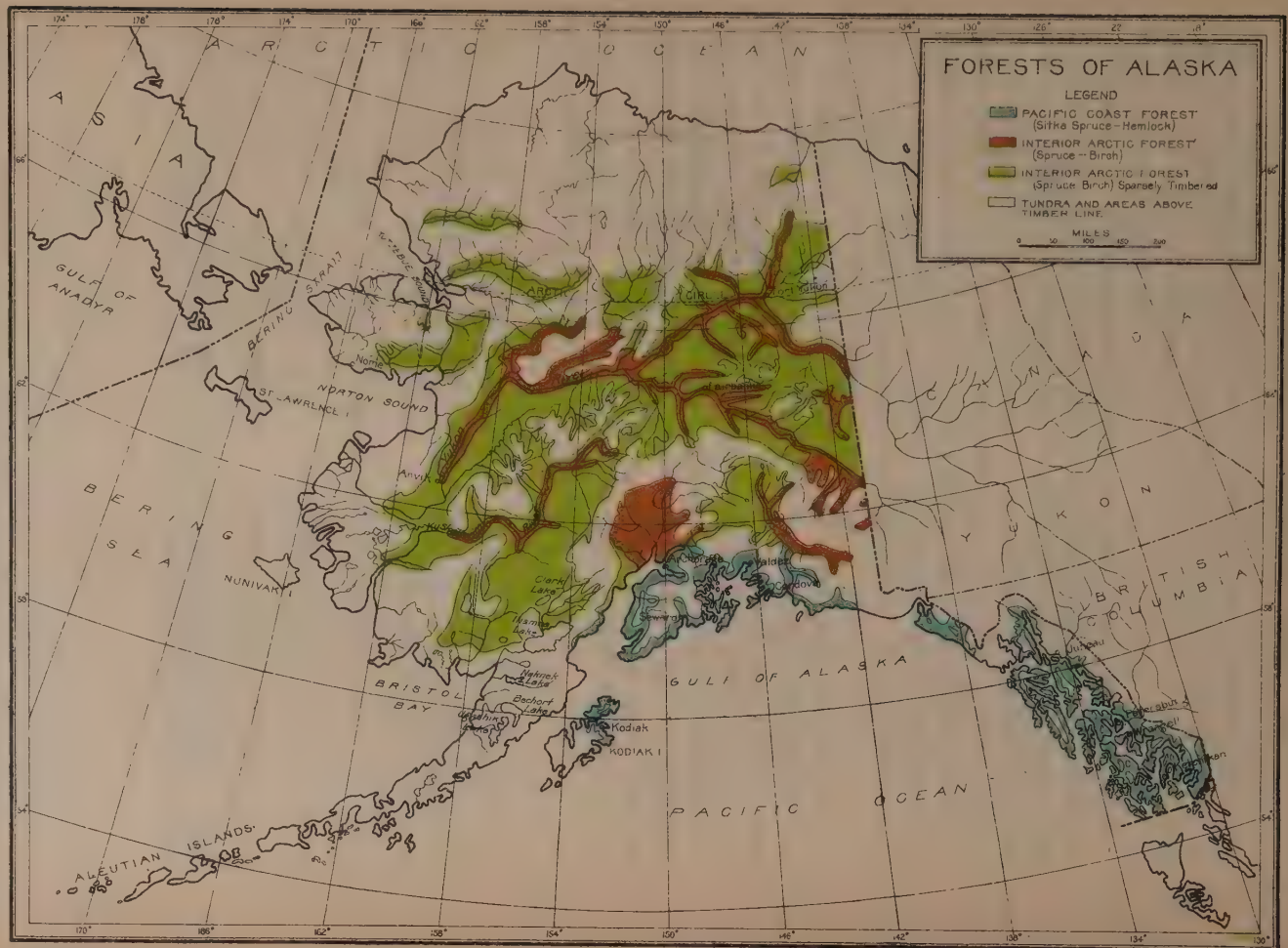
The Stand.—The total stand of the coast forest comprised in the two National Forests is estimated to amount to about 77 billion feet board measure of merchantable timber, or 3,742 board feet per acre. The interior forest will average about 500 board feet per acre, or from 25 billion to 65 billion board feet, or for entire Alaska from 102 to 142 billion feet board measure.

Annual Growth.—No estimates are available on the annual increment. The forests of Alaska at present are in a state of equilibrium, the growth being offset through loss by fire and waste.

Annual Cut.—No statistics are available as to the total annual cut in Alaska. The cut on the two National Forests averaged for the last five years 52 million board feet, including amount cut under sales and for free use. In the interior forests the cut of saw timber may be placed at 3 million board feet. The total cut of saw timber for entire Alaska is therefore probably about 55 million board feet (12,000,000 cubic feet of standing timber). At present there are 30 sawmills in Alaska.

Loss.—The interior forest receives no protection from fire although the fire hazard is very much greater than in the forests on the coast, and enormous areas have been burned over. Practically every summer witnesses extensive forest fires in this region, which burn unchecked, unless they threaten communities or improvements.

Exports and Imports.—Some of the Sitka spruce is being exported to points as far east as Illinois, New Jersey, and Ontario, while small amounts of hardwoods and Douglas fir are imported. The exports and imports about balance. The average annual exports from Alaska for the five-year period 1915-1919 amounted to 680,000 board feet (55,000 cubic


FORESTS OF ALASKA
LEGEND
PACIFIC COAST FOREST (Sitka Spruce - Hemlock)
INTERIOR ARCTIC FOREST (Spruce - Birch)
INTERIOR ARCTIC FOREST (Spruce Birch) Sparsely Timbered
TUNDRA AND AREAS ABOVE TIMBER LINE
MILES
0 50 100 150 200
ARCTIC OCEAN
ASIA
GULF OF ANADYR
BERING STRAIT
BERING SEA
NORTON SOUND
ST. LAWRENCE I.
NUNIVAK I.
BRISTOL BAY
GULF OF ALASKA
PACIFIC OCEAN
ALEUTIAN ISLANDS
KODIAK I.
YUKON
BRITISH COLUMBIA
Nome
Kotzebue
Barrow
Kiruna
Arctic Circle
Anvik
Kuskokwim
Clark Lake
Naknek Lake
Iliamna Lake
Becharof Lake
Kodiak
Yakutat
Juneau
Skagway
Whitehorse
Dawson
Mt. McKinley
Mt. Logan

feet), and imports for the same period averaged 609,000 board feet (50,000 cubic feet). The export of spruce, however, has just begun. In 1917 it was only 122,000 board feet, while in 1918 it was 598,000 and in 1919, 1,083,000 board feet.

Domestic Consumption.—Since the loss from fire and decay is compensated by growth, and exports and imports balance, the amount of saw timber used in Alaska is about 55 million board feet, or about 1,000 board feet per person. To this must be added the cut for fuel and other minor products, which in Alaska must be about the same as it is in Canada, namely, about 200 cubic feet per person, or 11 million cubic feet for the entire population. The total consumption, allowing 5,000 cubic feet for export, would thus be in the neighborhood of 23 million cubic feet, or 418 cubic feet per person.

Probable Future.—It has been estimated that the local needs of the territory for lumber, piling, railroad ties, box material, mine timber, and the like, during the next 10 or 15 years will reach 200 million board feet annually. After allowing for this and a small export trade there will remain approximately 100 million cords of timber suitable for the manufacture of newsprint and other grades of paper on the two National Forests, which will probably sustain a permanent yearly cut of 2 million cords of pulpwood. This is sufficient to manufacture one-third of the pulp products now consumed in the United States.

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CHAPTER V

THE FOREST SITUATION IN CENTRAL AMERICA, MEXICO, AND THE WEST INDIES

CENTRAL AMERICA

BRITISH HONDURAS (BELIZE)

Extent of Forests.—The area of forest land in British Honduras was estimated in 1920 as 3,826,666 acres, or 75 per cent of the total area of the country. Of the other 25 per cent, only about 15,000 acres is cultivated and 10,000 acres pastured, the remainder being classified as swamp, lagoon, and waste. The extensive mangrove areas along the coast probably are not included in the estimated forest area. Not including mangrove swamps, there is about 90 acres of timberland per capita. As the areas of cultivated and pastured lands indicate, very little clearing has been done, nor does it seem likely to progress rapidly in the near future.

Character and Distribution of Forests.—There are several distinct belts of vegetation, beginning with the tidal flats of the coast and rivers, which are largely occupied by mangroves. Next comes the low pine ridge belt, principally in the central and southern parts of the colony, covered with open stands of pines, of which there are at least two species, a longleaf and a shortleaf. This type occupies about one-third of the entire colony, or 1,706,666 acres, and stands average at least 25 merchantable trees to the acre, making a total of at least 10 billion board feet.

In the northern part of the colony, and to a less extent back of the pine lands in the south, are the cohune ridges and flat hardwood lands, bearing cohune palms in almost pure stands in some districts, or more often mixed with tropical hardwoods of many kinds. Mahogany, cedar, rosewood, logwood, santa maria, cotton tree, and other species are common in this type, which is the only one exploited commercially. It occupies most of the country not covered by pines or mangroves, except for the hilly western and southwestern districts, which culminate in the Cockscomb Mountains, at about 4,000 feet elevation. This region also is covered with tropical hardwood forest but, lacking transportation facilities, has not been developed.

Ownership of Forests.—Of the total land surface, 2,826,000 acres is reported to be owned by the crown, and 2,280,666 acres by private

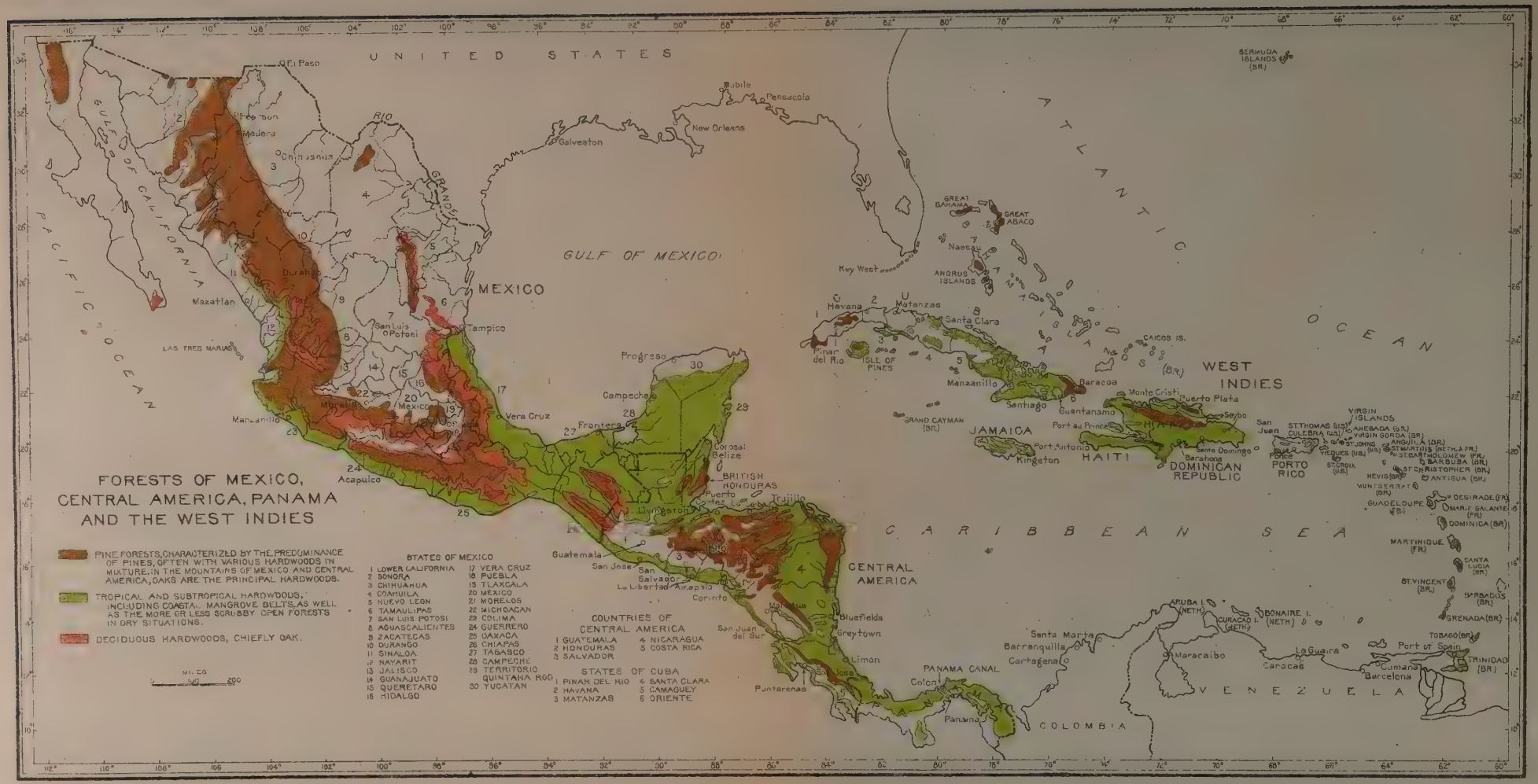
FORESTS OF MEXICO, CENTRAL AMERICA, PANAMA AND THE WEST INDIES
PINE FORESTS, CHARACTERIZED BY THE PREDOMINANCE OF PINES, OFTEN WITH VARIOUS HARDWOODS IN MIXTURE. IN THE MOUNTAINS OF MEXICO AND CENTRAL AMERICA, OAKS ARE THE PRINCIPAL HARDWOODS.
TROPICAL AND SUBTROPICAL HARDWOODS, INCLUDING COASTAL MANGROVE BELTS, AS WELL AS THE MORE OR LESS SCRUBBY OPEN FORESTS IN DRY SITUATIONS.
DECIDUOUS HARDWOODS, CHIEFLY OAK.
MILES
STATES OF MEXICO
1 LOWER CALIFORNIA
2 SONORA
3 CHIHUAHUA
4 COAHUILA
5 NUEVO LEON
6 TAMAULIPAS
7 SAN LUIS POTOSI
8 AGUASCALIENTES
9 ZACATECAS
10 DURANGO
11 SINALOA
12 NAYARIT
13 JALISCO
14 GUANAJUATO
15 QUERETARO
16 HIDALGO
17 VERA CRUZ
18 PUEBLA
19 TLAXCALA
20 MEXICO
21 MORELOS
22 MICHOACAN
23 COLIMA
24 GUERRERO
25 OAXACA
26 CHIAPAS
27 TABASCO
28 CAMPECHE
29 TERRITORIO QUINTANA ROO
30 YUCATAN
COUNTRIES OF CENTRAL AMERICA
1 GUATEMALA
2 HONDURAS
3 SALVADOR
4 NICARAGUA
5 COSTA RICA
STATES OF CUBA
1 PINAR DEL RIO
2 HAVANA
3 MATANZAS
4 SANTA CLARA
5 CAMAGUEY
6 ORIENTE
UNITED STATES
MEXICO
GULF OF MEXICO
CARIBBEAN SEA
ATLANTIC OCEAN
PACIFIC OCEAN
GULF OF CALIFORNIA
RIO GRANDE
CENTRAL AMERICA
WEST INDIES
JAMAICA
HAITI
DOMINICAN REPUBLIC
PORTO RICO
PANAMA CANAL
COLOMBIA
VENEZUELA
BERMUDA ISLANDS (BR.)
GREAT BAHAMA
GREAT ABACO
ANDROS ISLANDS
CAICOS IS. (BR.)
GRAND CAYMAN (BR.)
VIRGIN ISLANDS
ANEGADA (BR.)
VIRGIN GORDA (BR.)
ANGUILLA (BR.)
ST. MARTIN (NETH. & FR.)
ST. BARTHOLOMEW (FR.)
BARBUDA (BR.)
ANTIGUA (BR.)
ST. CHRISTOPHER (BR.)
NEVIS (BR.)
MONTSERRAT (BR.)
GUADELOUPE (FR.)
DESIRADE (FR.)
MARIE GALANTE (FR.)
DOMINICA (BR.)
MARTINIQUE (FR.)
SANTA LUCIA (BR.)
ST. VINCENT (BR.)
BARBADOS (BR.)
GRENADA (BR.)
TOBAGO (BR.)
TRINIDAD (BR.)
ARUBA I. (NETH.)
CURACAO I. (NETH.)
BONAIRE I. (NETH.)
El Paso
Mobile
Pensacola
New Orleans
Galveston
Key West
Havana
Matanzas
Santa Clara
Pinar del Rio
ISLE OF PINES
Manzanillo
Baracoa
Santiago
Guantanamo
Monte Cristi
Puerto Plata
Seybo
San Juan
Santo Domingo
Barahona
Port au Prince
Port Antonio
Kingston
Mazatlan
Durango
Chihuahua
Monterrey
Tampico
San Luis Potosi
Mexico
Vera Cruz
Manzanillo
Acapulco
Progreso
Campeche
Frontera
Corosal
Belize
BRITISH HONDURAS
Puerto Cortes
Trujillo
Livingston
Guatemala
San Jose
San Salvador
La Libertad
Amapala
Corinto
Managua
Bluefields
Greytown
Limon
San Juan del Sur
Puntarenas
Colon
Panama
Santa Marta
Barranquilla
Cartagena
Maracaibo
La Guaira
Caracas
Cumana
Barcelona
Port of Spain

PLATE XIII

FORESTS OF MEXICO, CENTRAL AMERICA, AND THE WEST INDIES

(*Facing page 558*)

individuals or corporations. Most of the land in private ownership is in the form of large grants or concessions, obtained for the logwood, cedar, and mahogany, and it is probable, therefore, that of the total forest area given above, about 2,256,666 acres is held in private ownership, while 1,570,000 acres belongs to the crown. Most of the private land is in very large tracts, three being reported to contain 1,250,000 acres, 500,000 acres, and 300,000 acres, respectively, a total of 2,050,000 acres. Private owners control most of the good mahogany lands, while the pine lands are still largely in government ownership.

Annual Growth, Annual Cut, and Losses.—Growth of many of the species is rapid, while some grow at phenomenal rates, especially on cut-over areas. Clearing for purposes of settlement is progressing very slowly, while timber operations take only scattered trees from the forest. It is probable, therefore, that the growth maintains an equilibrium with the cut, neither being anywhere near as much as the forests are capable of producing. The annual cut is comparatively small, amounting to about 9,000,000 board feet of domestic construction material, and mahogany and cedar for export, and possibly 600,000 cubic feet of fuel wood, dyewoods, and other material. The total cut is about 1,350,000 cubic feet. As far as reported, damage from forest fires is not especially serious. Some timber is destroyed by the hurricanes which occasionally sweep across the region.

Exports and Imports.—British Honduras began as a logwood and mahogany-cutting settlement in 1662, and for 260 years the timber industry has been the mainstay of the colony. Mahogany exports amounted to more than 2,000,000 board feet in 1802, and increased to 13,700,000 feet in 1846. They have since varied widely from year to year, but now average nearly 8,000,000 feet, not including the Guatemalan and Mexican mahogany, which is reexported through Corosal and Belize. Cedar exports amount to a little more than 500,000 board feet a year, and a few hundred tons each of rosewood and fustic are exported. Logwood for many years exceded mahogany in value of exports, but in 1901 was passed by mahogany, and in 1905 by chicle. During the period 1884–94, the average export of logwood was about 16,000 tons, but it is much less now, owing to depletion of accessible supplies and the competition of synthetic dyes. The total exports of all timber at present are approximately 875,000 cubic feet. Mahogany and cedar were exported during the period 1915–19, as follows:

	M. bd. ft.
Average annual export mahogany (domestic origin)	7,755
Average annual export mahogany (Mexican and Guatemalan)	856
Average annual export cedar (domestic)	551
Average annual export cedar (Mexican and Guatemalan)	144

The average value of domestic cedar and mahogany shipped during the period was $479,000 a year. Cedar and mahogany go to the United States and Great Britain in approximately equal amounts, while Great Britain takes most of the logwood.

Although possessing large areas of pine, it has been so costly to develop, in face of the competition of cheap lumber from the southern United States, that most of the lumber used in the country is yellow pine from the United States. The average importation of rough and dressed lumber during the period 1914–19 was 1,450,000 board feet a year (120,000 cubic feet) valued at $41,600. All was yellow pine, except for very minor quantities of white pine, oak, and cypress. Small amounts of shooks, staves, sash, doors, and molding are imported also.

Domestic Consumption.—Domestic consumption of wood is very small. The population, only a little more than 40,000, engaged principally in forest work, does not require much timber. There are few wood-using industries, and only 25 miles of railroad, which burns imported coal. Wood, principally mangrove, is used for domestic fuel, but the consumption for this purpose probably does not exceed 420,000 cubic feet. The total consumption is estimated at approximately 595,000 cubic feet, or 14 cubic feet per capita.

The Lumber and Wood-Using Industries.—Roads, railroads, or other transportation facilities are lacking, and all timber has to be taken out by water. The result is that most of the cedar, mahogany, logwood, and other desirable species close to the rivers have been cut out and production has declined, although there are extensive bodies of equally valuable timber farther back from the streams. The pine is very resinous and heavy, and will not float when green, so it, too, has remained almost untouched. It is estimated that fully 60 per cent of the forest can not be exploited until roads and railroads are built.

The lumber industry, or rather the logging industry, for 250 years has been the principal industry of the colony, and for 200 years it was practically the only one. Methods used are still rather crude and wasteful, both of labor and of material. The industry centers chiefly along the Belize River (Old River), with headquarters at Belize, and the New and Hondu Rivers, with headquarters at Corosal. Since only the larger trees are usually cut and growth is very rapid, cuttings can follow at 30-year intervals without greatly affecting the stand.

There are but few sawmills in the colony and they have a very small output. An attempt was made several years ago to start a sawmill industry in the pine belt, but it was later abandoned.

Wood-using industries are of little importance, most of the manufactured products used in the colony being imported. There are a few

boat-building establishments which use domestic woods, and some logging trucks and other vehicles are made.

Forestry Legislation.—Up to 1920 there was no forestry legislation other than laws relating to the payment of royalties on timber cut from crown lands. It is understood that the establishment of a forestry department is now under consideration.

Secondary Forest Products.—Chicle has recently become one of the leading products of British Honduras, almost equaling mahogany in value. In 1923, more than 2,100,000 pounds, worth over $625,000, was exported to the United States.

Small amounts of wild rubber are gathered, but the industry is of little importance. About 23,000 pounds was exported in 1913.

The mangrove belt is a potentially valuable source of tannin, and the pine ridges may become the seat of a considerable naval stores industry, since the pines are rich in resin.

The Probable Future.—British Honduras will continue to export hardwood timber for many years and may also export considerable yellow pine. As the virgin pine of the southern United States becomes depleted, it will be possible to develop transportation facilities and log the domestic pine at a profit. When this is done, not only will the domestic requirements be met without importation, but there will be a considerable surplus, even though home requirements increase greatly.

Trees of British Honduras.—There are said to be more than 100 species of trees which have potential value. Among them are the following:

TABLE 289.—PRINCIPAL TREES, BRITISH HONDURAS

Allspice (*Eugenia pimenta*) is used for canes.

Augusta is a hardwood species.

Axe-master has very hard wood.

Balsa (*Ochroma lagopus*) is plentiful and grows rapidly. Logs 20 feet long and 10 inches square are not uncommon. Balsa is exported in small quantities to the United States.

Banock is a valuable hardwood species.

Bastard lignum vitae, or pix, is a medium-sized tree with hard, tough wood, used for piling in salt water.

Billy Webb has heavy, tough wood, resembling an inferior grade of lignum vitae. It reaches fairly large size, and is abundant. Its principal use locally is for parts of logging trucks and carts.

Black maya, boy's job, and bull-hoof are valuable hardwood species.

Braziletto or brazil wood (*Caesalpinia* sp.) yields a dyewood, and is also of some value for timber.

Cabbage-bark (*Andira inermis*) is somewhat similar to Billy Webb, and is used for the same purposes.

Cacao (*Theobroma cacao*) produces cacao, from which cocoa and chocolate are made.

Cashew (*Prosopis* sp.) has hard, durable wood, and yields a gum similar to gum arabic.

Cedar (*Cedrela odorata*) reaches large sizes, and the wood is of excellent quality. Considerable quantities are exported.

TABLE 289.—PRINCIPAL TREES, BRITISH HONDURAS—*Continued*

Cohune palm (*Attalea cohune*) comprises from 20 to 30 per cent of the forest in some districts. It is specially valuable for its oily nuts.

Corkwood (*Anona palustris*) has very light wood, used for box-lining and bottle stoppers.

Crabwood (*Carapa guianensis*) occurs in the colony, but has probably been introduced from elsewhere.

Dogwood (*Piscidia erythrina*) is a valuable hardwood species.

Emery is one of the most abundant trees of the colony. Its light, soft wood can be substituted for most uses to which poplar is adapted. It is used for common lumber and interior finish.

Fiddlewood (*Citharexylon* sp.) is a valuable hardwood species.

Fustic (*Maclura*, or *Chlorophora*, *tinctoria*) is fairly common, and small quantities are exported for dyewood.

Granadilla is an excellent cabinet wood species.

Grape (probably *Coccoloba uvifera?*), habing, halfcrown, and John Crow wood are of some value.

Ironwood (*Laplacea haematoxylon*) has very hard, fine-grained wood, used for beams and for logging trucks.

Locust (*Hymenaea courbaril*) is a common tree with heavy, tough, close-grained wood, used for mahogany trucks. It is comparatively small.

Logwood (*Haematoxylon campechianum*) is of especially good quality in British Honduras.

Madre de cacao (*Erythrina umbrosa*) has hard, tough wood, used for construction, posts, and cabinet work.

Mahoe or mojo (*Paritium elatum* or *P. tiliaceum*) is a common tree of rapid growth, which has dark, greenish wood, and whose bark yields long fibres used for making rope.

Mahogany (*Swietenia mahagoni*) is of excellent quality in the northern part of the colony. South of Belize it is not so good. In that region it is called baywood.

Mangroves (including *Rhizophora mangle*, *Laguncularia racemosa*, and others) furnish firewood and a little tanbark. They are very abundant along the coast.

Miladi has hard yellow wood, used for carpentry and cabinet work.

Mountain plum is of some value.

Oaks (*Quercus* spp.) occur in the mountain district, where they reach large size and are valuable for timber.

Negrito is a fairly large, tall tree, used for masts.

Palmetto and various palms furnish wood that is occasionally used. Palmetto has a very hard wood, taking a high polish, and is used in furniture and inlaid work.

Pigeon wood is a hardwood species.

Pine (*Pinus cubensis*, or a similar species, and a "shortleaf" or "loblolly" pine of another species) is the most abundant tree in the colony. The wood is hard, resinous, and durable when seasoned. Used a little for construction, and more for fuel, but suitable for general uses as lumber.

Poisonwood is a large tree with hard wood which is used in cabinet work.

Pollack, polach or cottontree, is an abundant tree, especially on cut-over areas. It averages about 15 inches in diameter and 15 to 20 feet in height, has soft wood resembling cottonwood, and can be used as a poplar substitute for interior construction or for boxes. It will also probably make good paper pulp, and can be grown to pulpwood size in 5 years. The fruit bears a short, brown, silky cotton, used for stuffing mattresses and pillows.

Provisionwood has soft wood, probably suitable for paper pulp.

Purpleheart, redwood, and rosewood are cabinet wood species. Small quantities of the last are exported. The wood is dark red, hard, heavy, and fine-grained.

TABLE 289.—PRINCIPAL TREES, BRITISH HONDURAS—*Continued*

Salmwood, or samwood (*Jacaranda* sp.), has fairly light, durable wood, used for railway ties and for lining chests and wardrobes. It is avoided by moths and other insects. The heartwood is said to be immune from attack by teredo.

Santa Maria (*Calophyllum calaba*) has hard, durable wood, harder than the oak. It reaches large sizes, being obtainable in logs 24 inches square and 50 feet long, and is very abundant, comprising 20 per cent or more of the stand in some districts. It will often run from 2,000 to 4,000 board feet per acre. It is used for general construction, shingles, and shipbuilding. The seeds yield an oil good for illuminating purposes.

Sapodilla (*Achras sapota*) has very hard, durable, reddish wood, excellent for cabinet work, and used locally for bridges and house frames. It is fairly common, and reaches large sizes. Since the development of the chicle industry, this tree is cut less than formerly, being more valuable for its gum.

Satinwood, turtlebone, zebra, ziricote, and wynaka furnish cabinet woods.

Tolu balsam (*Myroxylon toluifera*) is the source of a medicinal balsam.

Toonu (*Castilloa elastica*) is the native rubber tree. It reaches a diameter of 2 feet, and heights of from 40 to 50 feet.

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COSTA RICA

Extent of Forests.—Data as to the forest areas of Costa Rica are very fragmentary. In 1890 about 95 per cent of the total land area, or 11,400,000 acres, was forested. Since then the population has increased at least 100 per cent, and much clearing has been done, since agriculture is the principal industry. It is probable, however, that at least 75 per cent of the total area, or about 9,000,000 acres, may still be classed as forest land. This is approximately 20 acres per inhabitant.

Character and Distribution of the Forests.—Costa Rica is essentially a mountainous country, with elevations varying from sea level to 11,500 feet. The mountains are interspersed with valleys and mesas,

and the provinces of Limon, Guanacaste, and Puntarenas (northeast, northwest, and southwest) contain considerable areas of level or rolling land. The soil is rich and deep, even on most of the mountain slopes, and the whole country is covered with forest, except where it has been cleared for growing coffee, sugar, cacao, or other crops.

On the Pacific side there are numerous bays and inlets, with some areas of mangrove forest. The rest of the forest, except for some of the higher mountains where pines, oaks, and other trees of the temperate climates occur, is a dense tropical evergreen forest, containing a large number of valuable construction and cabinet woods. The southern limit of pine forests is reported to be at about 9° north latitude in the southwestern part of Costa Rica. There are 100 or more species of commercial size, not all of which have been exploited. The most important species so far are Spanish cedar (*Cedrela odorata*) and pochote (*Bombax ellipticum*). Others of the better known trees are mahogany, cocobolo, fustic, balsa, rosewood, granadillo, lignum vitae, guanacaste, and genizero (or cenizaro). Spanish cedar is about ten times as abundant as mahogany, and both occur chiefly on the Pacific side of the country. The forests of the Atlantic side have been little exploited, while those of the west coast, especially in Puntarenas and Guanacaste provinces, have been worked for many years. Even in those, however, lumbering has been confined almost entirely to the vicinity of the coasts and rivers, so a very large proportion is still virgin forest.

Ownership of Forests.—Most of the forests are still in public ownership. Up-to-date figures as to the amounts held by the state and by private owners are lacking; in 1890 it was estimated that public forests occupied 65 per cent of the total land area, forest concessions 15 per cent, and privately owned forests 15 per cent.

Annual Growth, Annual Cut, and Losses.—Timber grows rapidly in this region, and cut-over areas restock very quickly, so that growth has probably kept pace with cutting on the lands that have not been cleared for other use.

The annual cut is relatively large, for wood is used in building construction to a much greater extent than in most of the tropical countries. The cut of lumber, building timbers, and railroad ties and timbers is probably not less than 4 million cubic feet (48 million board feet), and may be considerably more. In addition, large quantities of wood are cut for fuel, fencing, and other purposes, probably aggregating at least 5 million cubic feet, making a total cut of 9 million cubic feet, or 1 cubic foot for each acre of forest land.

Costa Rica has a dry season from December to April, and inasmuch as the laws provide certain restrictions on the use of fire for clearing land it is probable that forest fires occur. The aggregate loss from this

cause is probably not very great. Much timber is destroyed in clearing land.

Imports and Exports.—Although Costa Rica has abundant forest resources and a fairly well developed and growing lumber industry, her requirements for lumber are so great that considerable quantities have been and still are being imported—practically all yellow pine from the United States. The annual imports before the war were about 7,000 metric tons (equivalent to about 350,000 cubic feet, or 4,200,000 board feet). They almost ceased during the war, but in 1919 had increased to about 900,000 board feet and in 1920 to 3,200,000 board feet.

Timber exports constitute a fairly important item in the foreign commerce of Costa Rica. As long ago as 1892 the value of such exports exceeded $200,000 a year, which is somewhat greater than the values in the years just preceding the world war. In 1913 the value was $141,000, consisting principally of cedar with smaller quantities of mahogany and cocobolo, while in 1914 it fell to $124,000. These values represent about 310,000 and 290,000 cubic feet, respectively. Germany took the greater part of the cedar in 1913 and Chile most of the remainder, while in 1914 more went to Chile than to Germany. The mahogany went principally to Germany and England, while the United States took most of the cocobolo. In 1917 the total exports were: cedar 4,060 metric tons; cocobolo 1,077 tons; mahogany 196 tons; other woods 2,930 tons. This was about 375,000 cubic feet, most of which went to the United States. Puntarenas is the chief center of the export business.

Domestic Consumption.—The use of timber in building dwellings has increased greatly during the last few years, and frame houses are now very common, especially in the towns. There are several hundred wood-working shops of various kinds, which use considerable quantities of wood in making furniture, cabinet work, sash, doors, vehicles, and other products. There are between 400 and 500 miles of railroad, and the boat-building industry also uses considerable wood. Agriculture and stock raising, the principal industries of the country, require large amounts of wood for various purposes, and the consumption of firewood or charcoal, almost the sole fuel for domestic use, is large. Altogether, the consumption of lumber and other material of saw-timber size is probably not less than 48,600,000 board feet (4,050,000 cubic feet), and of firewood, posts, and other material, not less than 5,000,000 cubic feet, making a total of 9,050,000 cubic feet, or about 19.5 cubic feet per capita.

The Lumber and Wood-Using Industries.—The lumber industry is further developed in Costa Rica than in any of the other Central American Republics. In 1916 there were reported to be 42 steam sawmills and 103 hand-sawing establishments. Later reports give 62 steam sawmills, with some planing mills in connection, and a total

of about 300 establishments, not all of which were operating. In 1918 the industry was reported to employ regularly about 800 men. Practically all the mills are rather small. The principal species cut are pochote and cedar, but a number of others are cut for local use, including genizero, quechimbo, guanacaste, mahogany, and palo maria.

In addition to the sawmills, in 1916 there were 373 wood-working establishments, including cabinet, furniture, and picture frame shops, sash and door frame makers, vehicle makers and wheelwrights, and millwork establishments. While most of them were small and not equipped with power driven machinery, the products were stated to be of very high grade. The lumber and secondary industries are growing rather rapidly, and a great expansion can be expected in the next few decades.

Forestry Legislation.—Although Costa Rica appears never to have developed a forest policy or enacted a comprehensive forest law, there have been several separate executive decrees concerning the conservation of forests. A decree of 1884 prohibited exploitation of either public or private forests in such ways that they would be destroyed or the flow of streams affected. Cutting in public forests required a permit from the President; trees on slopes or along highways were not to be cut; trees within 70 yards of streams on hillsides or within 45 yards in flat country were to be preserved even on private land. Later decrees provided for cutting timber or gathering gums and resins on the public forests, in accordance with special permits and regulations. Concessions may be granted in areas of 4 square miles. Large concessions are reported to have been made to private citizens in 1920, providing for cutting timber at a fixed fee per tree and also that two trees must be planted for each one cut. The use of fire in clearing land, even that privately owned, is forbidden except in especial cases.

Forest conservation is taught in all public schools, and a compulsory course on the subject is given in the high schools.

Secondary Forest Products.—Rubber was formerly produced and exported in greater quantities than it is now. It is gathered from wild trees (*Castilloa elastica*), none being grown in plantations. Small quantities are exported, but the total amount and value are comparatively insignificant. Considerable fustic, or palo de mora (*Chlorophora tinctoria*) is exported for making dyes. In 1920, 565 tons of dyewood were exported to the United States.

The Probable Future.—Domestic consumption will go on increasing for many years, probably at a considerably faster rate than the increase in population. At the same time the area of cultivated land will be very greatly extended, with corresponding reduction in the forest area. Practically all of the land below 4,000 feet, and much of that at higher elevations, is very well suited to agricultural use, and eventually will

be cleared, except small areas left as woodlots, windbreaks, or for protection of streams and slopes. The per capita consumption of fuel wood may decline considerably, because with the rapid development of hydroelectric resources cheap electric current is rapidly supplanting wood for cooking and heating. Costa Rica may continue to export limited amounts of cedar, mahogany, and other special woods, but will never be much more than self-supporting in timber products.

Woods of Costa Rica.—Among the more important Costa Rican trees are the following:

TABLE 290.—IMPORTANT TREES, COSTA RICA

Balsa (*Ochroma* sp.) has been exported in recent years, and plantations have been established for the purpose of producing it.

Braziletto or brazil (*Caesalpinia echinata*) has been exported in small quantities.

Cacique (*Eugenia lepidota*) is used locally for construction and other purposes.

Caobo or mahogany (*Swietenia* sp.) is not abundant, being found scattered along streams on the western slope. Small quantities are exported. The wood is of very good quality.

Cedro or Spanish cedar (*Cedrela odorata*) is fairly abundant on the west side, and is the most important timber tree in the country. It is widely used for construction and cabinet work, and considerable quantities are exported.

Cedro amargo (*Cedrela* sp.) is similar to cedro.

Ceiba (*Ceiba pentandra ?*) is used locally.

Cocobolo or cocabola (*Dalbergia* sp.) is a small tree of the western slope, used very little at home, but much exported for making knife and tool handles and brush backs. Logs more than 10 feet long are rare.

Fustic or palo de mora (*Chlorophora tinctoria*) is exported as a dyewood.

Genizero or cenizaro (*Pithecolobium* sp.) is a hard cabinet wood species.

Granadillo is valuable for cabinet wood.

Guachipelin is a hard wood species.

Guanacaste (*Enterolobium cyclocarpum*) is rather widely used locally.

Guapinol (*Hymenaea courbaril*) has hard wood of considerable value for construction and cabinet work.

Habillo or jabillo is used locally.

Laurel is employed for construction.

Lignum vitae or guayacan (*Guaiacum* sp. and *Tecoma* sp.) is the lignum vitae of commerce and a similar species.

Logwood (*Haematoxylon campechianum*), which yields a dyewood, is reported to occur in Costa Rica but is not exploited.

Mangle or mangrove (*Rhizophora mangle* and others) occur along the coast, especially on the Pacific side.

Nispero (*Sapota zapotilla* or *Achras sapota ?*) is valuable for its timber as well as for its fruit and gum.

Palo maria is of considerable local importance as a source of construction material.

Pochote (*Pachira* sp. or *Bombax ellipticum*) has wood somewhat resembling Spanish cedar, and excepting cedar is the most widely used timber of the country. Both it and cedar resist the attacks of termites, which makes them especially desirable building timbers.

Quechimbo is used locally.

Rosewood (*Dalbergia* sp.) is a cabinet wood species.

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GUATEMALA

Extent of Forests.—Approximately 65 per cent of the land area of Guatemala, or 20,000,000 acres, is forested. This is 9 acres per inhabitant. Some of the original forest has been cleared to make room for raising coffee, bananas, sugar, corn, and other crops, but there are no figures showing how much of the country was originally forested. The process of clearing is steadily though rather slowly going on.

Character and Distribution of Forests.—The distribution of forests in Guatemala is exceedingly uneven. The northern departments, Peten, Alta Verapaz, and Izabal, are largely covered with forest, especially the first, lying between Mexico and British Honduras, which includes nearly one-third of the total land area and has only 10,000 inhabitants. The southwestern departments also are fairly well timbered, and there is a forest belt about 25 miles wide along most of the Pacific coast. Above this is a fairly thickly settled agricultural region, with little timber growth. There are considerable areas of forest in the higher mountains, broken by practically treeless semi-arid valleys, such as that of the Motagua river.

The northern forests as well as those of the Pacific coast belt are of the dense evergreen tropical type, composed of hundreds of valuable species of trees. Mahogany, cedar, ceiba, laurel, zapote, and logwood are some of the better known. The Peten region is said to be the richest forest tract in Central America. The country is fairly level or rolling, with some open savannas towards the central and northwestern part. Mahogany trees are reported to occur at the rate of one large tree per acre, averaging about 8,000 board feet to the tree. Some trees contain 18,000 to 20,000 board feet. Although the Alta Verapaz and Pacific districts are mountainous, the composition of the forests is similar to those of Peten. There are belts of mangrove along both the Atlantic and the Pacific coasts.

The mountain districts have a cooler and drier climate, and the tropical forest is replaced by one composed of temperate hardwoods

and conifers. From 5,000 to 9,000 feet the forests are mixed pine and oak, containing several species of each, as well as liquidambar, cypress, and other trees. The proportion of pines increases with higher elevations and the oaks drop out. *Pinabete,* said to be a large spruce, but which is probably the fir (*Abies religiosa*) of southern Mexico, occurs toward the upper limits of the forest, above 13,000 feet. Some of the pines are extremely large, occasionally reaching 8 feet in diameter. While these forests contain a large amount of valuable construction timber, it is so hard to get out that they have been little exploited. Between 3,000 and 7,000 feet on the Pacific side most of the forests have been cleared away, and the land is under cultivation.

Ownership of Forests.—A very large proportion of the forest land of Guatemala is still owned by the state, but is under the control of the local authorities. Each municipality is allowed a certain area of forest sufficient to supply its needs, which it manages and practically owns, although title remains in the state.

Annual Growth, Annual Cut, and Losses.—Growth in the tropical forests is rapid, while in the pine and oak forests it is less so. Inasmuch as most of the forests are not being exploited and the forest area is being gradually reduced by clearing, the total net growth is probably somewhat less than the annual cut. Losses from fires and other causes, aside from the timber destroyed in land clearing, are not very great. Forest fires do occur in the mountain regions, and are probably responsible for the comparatively open stands found in many places.

The data on annual cut of timber are extremely fragmentary. Relatively small amounts are cut for domestic use, but considerable quantities of logs are exported. The total cut of large-sized material is probably about 12,000,000 board feet, or 1,000,000 cubic feet, and of fence posts, fuelwood, and other small-sized material, 20,000,000 cubic feet, making the cut of all material 21,000,000 cubic feet.

Exports and Imports.—Mahogany and Spanish cedar so far have constituted practically all of the timber exportation from Guatemala. The best and most accessible supplies on both the Atlantic and Pacific sides have been cut, but there are still large virgin areas in the Peten region, where most of the exports now originate. The logs are rafted down the Usumacinta River to Frontera, Mexico, whence they go to the United States, or down the Belize River to Belize, whence they go to England. Some are still shipped from the Atlantic ports of Sarstoon and Livingston and from the Pacific ports of Champerico and San Jose. For several years before the war total exports averaged about 5,000,000 board feet a year, or 420,000 cubic feet.

In spite of the abundant domestic supplies of timber, a considerable proportion of the construction lumber is imported from the United

States. The quantities imported have varied widely from year to year, as have also the kinds of timber. For instance, in 1894 the total quantity was about 2,500,000 board feet, nearly all redwood and Douglas fir. In 1918, 4,000,000 board feet was imported, composed of southern yellow pine, 56 per cent; redwood, 21 per cent; white pine, 15 per cent; Douglas fir, 6 per cent. The average normal imports are probably about 3,000,000 board feet (250,000 cubic feet), including small amounts of railroad ties, shingles, and sash, doors, and molding.

Domestic Consumption.—The use of wood for building in Guatemala is relatively small, compared with some of the other Central American states. There are about 500 miles of railroad, which import some of their construction timber and ties and use considerable domestic timber. Wood-using industries are few and unimportant. The largest consumers of lumber are the banana and coffee plantations, many of which import a large part of their requirements. While wood fuel is used for domestic purposes, coal and oil are imported for the railroads, and the wood fuel consumption per capita is probably less than in some of the neighboring countries. The total consumption of all kinds of wood is estimated at 20,830,000 cubic feet, or approximately 9.3 cubic feet per capita.

The Lumber and Wood-Using Industries.—The greater part of the forests of Guatemala is still virgin timber. Cutting has been confined mostly to within short distances of the coasts and rivers, where mahogany and cedar and a few other trees have been cut and floated down to the ports, whence they have been exported in the log. The domestic sawmill industry is of little importance, not being adequate to supply local timber requirements. The few mills are small, and are not equipped with dry kilns. The principal wood-using industries are the small shops making furniture, vehicles, and boats. Few, if any, of them use machinery, practically all of their products being made by hand.

Forestry Legislation.—There are no laws regulating forests in private ownership, but most of the forest land belongs to the state, which, in theory at least, exercises a certain amount of control over timber cutting.

A decree of 1888 provides that all lands belonging to the state, municipalities, and public bodies, covered with trees suitable for construction, fuel, charcoal, or other public use, are to be considered national forests. The governors of the several departments are required to see that the local authorities conserve the public forests, by prohibiting destruction of rubber, balsam, and gum-yielding trees, or of other trees along roads or within certain distances of stream sources. Cutting immature trees, destroying trees without utilizing them, and felling trees by the use

of fire are prohibited, while penalties are provided for both accidental and intentional setting of fires. The governors are also authorized to have trees planted along highways, prohibit cutting on hill-crests, and establish forests in such places if necessary for protection of the slopes.

A decree of 1892 provides for setting aside public forests for the use of municipalities, whose local officials must submit plans for the management of their reserves. In these forests, 5 trees of the same or more valuable species must be planted for each one cut.

The government has given some attention to developing the national forest resources and has granted various concessions for exploration of timber, gums, and other products.

Secondary Forest Products.—The rubber industry is steadily declining in importance. Exports in 1910 were about 175,000 pounds; in 1913, about 100,000 pounds. There are no plantations, the production being entirely from wild trees.

Chicle, practically all of which goes to the United States, is produced in the Peten region, in varying quantities. During the period 1909–1913 the average was 457,400 pounds, valued at $148,400.

Guatemala has valuable tannin resources, none of which are exploited. Divi-divi or a closely related species, also known as mascalote, is very abundant, and both coasts have considerable tracts of mangroves. Other potential sources of tannin are ron-ron, icaco, and various oaks (*Quercus* spp.).

Dyewoods include fustic, campeche (*Haematoxylon* sp.) and another logwood (*Genipa americana*).

Probable Future.—The greatest handicap in the way of development of the forest resources of Guatemala is lack of transportation. With an adequate system of railroads and highways, the mountain forests of oaks and pines will be able fully to meet domestic requirements for construction timber, and the tropical hardwood forests will afford a large surplus of wood for export, which, because of the closeness of this region to the United States, will find a ready market.

Guatemalan Trees.—A few of the economically valuable trees of Guatemala are listed below:

TABLE 291.—PRINCIPAL TREES, GUATEMALA

Bari has a yellowish wood, somewhat resembling mahogany. Occurs in the Peten district.

Camponillo has soft wood suitable for making boxes. Not much used.

Caracolilio resembles mahogany. Occurs in Peten.

Cedro or Spanish cedar (*Cedrela odorata*) is abundant, and reaches large sizes. It is much used for local construction, and is exported for manufacture of cigar boxes.

Ceiba is a very large tree, whose fairly soft lumber is employed for various purposes.

Chichipate has very hard wood, used locally for axles, wheels, and foundations. It is extremely tough and durable.

TABLE 291.—PRINCIPAL TREES, GUATEMALA—*Continued*

Chichique is somewhat like cedar.
Cenicero and coj resemble ash.
Conocaste is used for furniture, floors, and interior finish.
Corozo is a palm, of little value for timber but an important source of vegetable oil.
Cortez resembles ebony.
Cypress (probably *Cupressus benthami*) occurs in the mountains, where it reaches large sizes. It makes excellent soft lumber.
Genizaro is a valuable cabinet wood species.
Granadillo includes two species, one used for construction, the other for furniture.
Icaco (*Chrysobalanus icaco*) is valuable as a source of tannin.
Laurel blanco is a valuable tree of the Peten district.
Liquidambar (*Liquidambar styraciflua*) occurs in the mountains. It is valued chiefly as a source of gum.
Logwood (*Genipa americana*) yields a blue dye. Another logwood, or *campeche*, (*Haematoxylon* sp.) yields violet dye. These are abundant in the tropical forest.
Mahogany, or caoba (*Swietenia mahagoni*) is the best known and most extensively exploited tree in Guatemala. It is still fairly abundant in the Peten district, where it reaches very large sizes.
Mangle, or mangrove (*Rhizophora mangle* and others), occur along tidal flats on both coasts.
Mario has hard wood, which twists and warps badly, and therefore is little used.
Mascalote, or divi-divi (*Caesalpinia* sp.) bears pods which are exceedingly rich in tannin, but are not utilized to any extent.
Matilisquate has hard wood, and is consumed locally.
Medallo has wood of medium hardness, which takes a fine polish. It is suitable for brush backs, picture frames, and interior finish.
Mora, or fustic (*Maclura* or *Chlorophora tinctoria*), is a valuable dyewood, and is also used for furniture and interior finish.
Piche is a valuable tree of the Peten district.
Palo blanco is very resistant to fire.
Palo negro makes good railroad ties.
Palo santo, guayacan, or lignum vitae (*Guaiacum sanctum*) is well known.
Pinabete (probably *Abies religiosa*) is a large tree of the high mountains. Because of its inaccessible location, it is of little economic importance.
Pines include several species, most of them excellent timber trees, but so far little utilized because of their location in the mountains. The following species have been reported to occur in Guatemala: White pines—*Pinus ayacahuite, P. donnell-smithii, P. filifolia, P. oocarpa, P. tenuifolia;* yellow pines—*P. cubensis, P. leiophylla, P. teocote.* The yellow pines are rich in resin.
Roble, or oak (*Quercus* spp.), includes several species of oaks, valuable both for timber and for tanbark.
Ron-ron contains tannin.
Rosewood, or a similar tree, occurs in the tropical forest.
Voladora has tough, elastic wood, suitable for masts.
Zapote or chicozapote is the source of chicle, which is exported for making chewing gum.

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HONDURAS

Extent of Forests.—The forest area of Honduras is approximately 23,700,000 acres, or 80 per cent of the total land area. This is 37 acres per inhabitant. Originally the area of forest was somewhat greater, probably 95 per cent of the total. Much land has been cleared for agricultural use, however, and this clearing is still going on. Because of the practice of shifting cultivation by the native population, much more land is cleared than would otherwise be the case.

Character and Distribution of Forests.—Honduras is mostly mountainous or hilly; the northern and eastern parts are lower and less broken than the south and west, with considerable expanses of plains and plateau. The character of forest growth varies with the altitude and precipitation. The Atlantic coast and the short stretch of coast line on the Pacific, as well as the shores of Roatan and other islands, are lined with belts of mangrove.

Above these, extending to about 2,000 feet elevation, is the "terra caliente," or hot belt, mainly covered with tropical evergreen forest. There are, however, extensive tracts of pine ridge land covered with *Pinus cubensis,* especially in the Department of Mosquitia, the eastern part of the country. The pine stands are rather open, with trees from 18 to 24 inches in diameter (sometimes larger), and average stands over large areas from 4,000 to 7,000 board feet per acre. Palms (corozo or cohune palm, *Attalea cohune*) also occupy considerable areas of the coastal plain region. The hot belt occupies about one-fourth of the country, and is mostly on the Atlantic side. Honduras has only a short frontage on the Pacific coast, and the timber there is hardly sufficient to supply local requirements. The forests of this region have been exploited near the coasts and along the rivers, principally for mahogany, cedar, rubber, and some dyewoods. Comparatively little has been cleared, except for the banana plantations, which are now being extended fairly rapidly near the Gulf coast. The stand of timber in this region has been estimated at 90,000,000 merchantable pine trees and 60,000,000 to 65,000,000 mahogany and other valuable hardwoods. This would

probably be equivalent to about 30,000,000,000 board feet of pine and at least an equal quantity of hardwoods. There are reported to be additional large quantities of softwoods suitable for making paper.

From about 2,000 to 5,700 feet is the "terra templada," or temperate belt, which has a more or less sub-tropical flora composed of many of the species of the hot belt, with others not found there. Near the summits of the mountains on the eastern side is a region of heavy rainfall, with dense sub-tropical hardwood forests. The temperate belt merges into the "terra fria," or cool belt, which has mixed hardwood and conifer forests, consisting principally of various pines and oaks, with some cypress, liquidambar, alder, and others. Both belts are interrupted by many open savannas.

Ownership of Forests.—While statistics of ownership are not available, it is known that the greater part of the forest land is owned by the state. Because of a technical lien of the holders of Honduran bonds, the government does not alienate any more of its public land, but grants leases for 99-year periods.

Annual Growth, Annual Cut, and Losses.—No figures as to annual growth are available. Growth of individual trees of many of the species, especially in the tropical belt, is rapid. It is probable, however, the net total increment is hardly equal to the amount cut or otherwise destroyed. Besides the timber cut for use, large quantities are destroyed in clearing land. The pine ridge district and the pine and oak forests of the mountains also suffer from numerous fires. In some sections, especially in the mining region, the timber is already becoming so depleted that consideration is being given to the possibility of growing timber in plantations.

The annual cut of saw-timber, ties, logs for export, and other construction material is probably at least 13,200,000 board feet, or 1,100,000 cubic feet, and for posts, fuelwood, and other small material, at least 6,000,000 cubic feet, or 7,100,000 cubic feet altogether. Most of the cut consists of hardwoods; some pine is cut for local use in the north, and small quantities cut in the mountains are consumed in Tegucigalpa and other towns of the south.

Imports and Exports.—Although possessed of abundant forests of yellow pine, northern Honduras still imports practically all of its construction timber from the southern United States, as it has done for many years. Some of the larger plantations operate sawmills to cut timber for their own use, and the railroads also meet some of their own needs with local timber. The more populous southern part of the country uses native timber for the most part. Total imports from the United States (which supplies practically the whole amount) during the three years 1918-1920 were:

	M bd. ft.
Logs and timber	623
Lumber:	
Yellow pine	11,882
Cypress	2,899
Other	119
	value
Railway ties	$437,485
Doors, sash, molding, shingles, shooks, etc	$75,785

The total quantity amounted to approximately 2,300,000 cubic feet, of which two-thirds was imported in 1920. The normal annual import is probably about 1,000,000 cubic feet.

Exports of timber formerly were considerably greater than they have been in recent years, because the mahogany and cedar timber readily accessible from the coast and larger streams has been cut. A considerable part of the total now goes to the United States. During the war exports of fustic were much greater in quantity than those of cedar and mahogany, and some balsa also was sent to the United States. Although the figures vary widely from year to year, the average annual export of timber and dyewoods may be estimated at about 100,000 cubic feet. Most of this goes through the ports of Trujillo and Puerto Cortes, on the north coast.

Domestic Consumption.—Adobe and brick are the common building materials of Honduras, and therefore the consumption of lumber is small. Some of the banana and other large plantations, the railroads, and the larger mining companies are the principal consumers. Some lumber also is used for boxes for candles, bottled goods, soap, and other products, and small quantities are employed for furniture, vehicles, and other manufactured articles. Many wooden boats are in use along the coasts and rivers. The total consumption of wood is estimated at not less than 8,000,000 cubic feet, including fuelwood. This is 12.7 cubic feet per capita.

The Lumber and Wood-Using Industries.—Honduras is handicapped by lack of transportation facilities, especially in the forest districts. Because of this lack, the forest resources have not been exploited, except near the coasts and close to the larger streams, where cedar, mahogany, and fustic logs have been cut for export. Most of the rivers, except those in the east, are too rough for driving logs, although some are used for that purpose. The more populous southern third of the country has comparatively inaccessible forests, which supply the limited local requirements but furnish no material for export. A few of the larger plantations on the north coast and also some of the railroad and mining companies operate small sawmills to cut their own lumber. Aside from these, there are very few mills in the country. The

great bulk of the cut is sawed or hewed out by hand. Very little cutting has been done in the pine forests, although several small mills have operated there. The industry promises to develop in eastern Honduras, along with the naval stores industry, as the southern pine region of the United States becomes depleted.

Wood-using industries are of very little importance in Honduras. Small local shops make furniture, interior finish, carts, boxes, and other products for local use, mostly by hand.

Forest Legislation.—For many years timber could be cut free of charge on public lands, provided proof was given that it would be utilized and not wasted. The government obtained its return by levying an export duty on material shipped out of the country. The law of 1909, however, changed the policy of disposing of public timber. All "precious and useful" woods on the public lands are declared reserved to the state, and are not to be included in grants of the land made under the mining and agrarian laws. Such woods may be exploited only under special contract, after sale to the highest bidder, and payment is made according to the quantities cut. Wood may not be transported without a license from the Collector of Revenue, showing its origin, destination, and certain other facts.

Secondary Forest Products.—Rubber is produced in small quantities, principally from wild trees, but partly from plantations. The total export in 1888 was 137,871 pounds, practically all of which went to the United States. The output has declined gradually, until in 1913-1914 the average annual export was only a little over 42,000 pounds.

Other gums and resins include chicle, gathered in small quantities; liquidambar, of which 5,375 pounds was exported to the United States in the two-year period 1913-1914; Peruvian balsam; and gum copal. Dyewoods include fustic, also called mora and yellow-wood, which forms an important export commodity, brazilwood, and logwood. Several other dyes are produced from forest plants.

The naval stores industry promises to be of much importance within a few years, and several companies are already operating in a small way. The pine of the eastern Honduras sand ridge country is *Pinus cubensis*, or a very similar tree, and is rich in resin. One or two of the yellow pines of the mountain region are also valuable for their resin, notably ocote, or *Pinus teocote*. Altogether there is several million acres of pine timber capable of yielding turpentine.

The Probable Future.—Honduras has a considerable surplus of timber, including several pines, over what will be required within the country for many years. Its geographical location, close to the West Indies and to the southern United States, is such that its forests are almost certain to supply a considerable volume of timber for export within the

next decade. With such development must come building of roads and railroads, and at the same time Honduras itself will probably develop requirements for several times as much lumber as is used now. Even allowing for the clearing of large areas for agricultural use, however, it is likely that the Republic can continue to export timber for many years if the forests are carefully handled.

Trees of Honduras.—Among the many commercially valuable trees of Honduras are the following:

TABLE 292.—PRINCIPAL TREES, HONDURAS

Alder (*Alnus sp.*) occurs in the "terra fria."
Algarroba is a leguminous tree, suitable as a substitute for boxwood.
Balsa (*Ochroma sp.*), or corkwood, is exported in small quantities.
Balsam.
Bamboo is very abundant along the rivers at lower elevations. It reaches diameters of from 4 to 7 inches and heights of 60 feet.
Bloodwood.
Boxwood.
Brazilwood (*Caesalpinia sp.*) is a dyewood.
Buttonwood is used for shipbuilding.
Cacique.
Calabash.
Camwood.
Caray, or tortoise-shell, grows in the lowlands.
Carbon.
Cedro (*Cedrela odorata*) has the most extensively used wood for general purposes. It is soft, strong, durable, and easy to work. Trees reach diameters of 4 and sometimes 7 feet, with 70 to 80 feet of merchantable length. Growth is rapid.
Ceiba (*Bombax ceiba*) the silk-cotton tree, is a common large tree. The wood is widely used for construction and general purposes.
Chilillo.
Chucho or dogwood is utilized for shipbuilding.
Cipres (probably *Cupressus sp.*) occurs in the pine forests of the mountains, and is useful for construction purposes.
Cocobolo has hard wood, used for handles.
Copaiba is the source of a balsam. The wood also is useful.
Cortez.
Ebano is of two sorts, the black and the white. Both are cabinet woods.
Fustic, yellowwood, or palo de mora, is an important dyewood, and its wood is used in cabinet work and for construction.
Granadillo is employed in shipbuilding.
Guachipilin.
Guanacaste or juanacosta is used for flooring and for boat building.
Guayacan, palo santo, or lignum vitae.
Ironwood.
Laurel is employed for construction and general purposes.
Liquidambar (*Liquidambar styraciflua*) is the source of a gum, some of which is exported.
Locust is used for general purposes.
Logwood (*Haematoxylon* sp.) is a valuable dyewood.

TABLE 292.—PRINCIPAL TREES, HONDURAS—*Continued*

Mahogany or caoba reaches large sizes, and is of excellent quality. It is used for shipbuilding, general construction, and furniture, and considerable is exported. Stands with one mahogany tree to the acre are considered good.

Mangroves (red, white, and black) (*Rhizophora mangle* and others) are potential important sources of tannin, being abundant on both coasts.

Nogal or walnut occurs in the mountains.

Palms, including corozo or cohune (*Attalea cohune*) and others, are common on the coastal and river plains, where they often form pure stands. The cohune is especially valuable for its oily nuts.

Palo devida.

Palo de tinto.

Palo negro.

Pino includes several pines, all of them excellent timber trees, and several potential sources of naval stores. The pine of the eastern coastal plain region is *Pinus cubensis* or a similar species, and the longleaf pine of the mountain region is probably *Pinus teocote*, *Pinus leiophylla*, or a similar species.

Quiebra-hacha or quebracho is a hard heavy wood, difficult to work. It is not related to the South American quebracho.

Roble (*Quercus* spp.) includes several species of oak, some of which are valuable timber trees, as well as sources of tanbark.

Ron-ron.

Rosewood is a fairly common cabinet wood of the warm belt.

Rubber or hule, occurs in the warm belt.

Sandalwood is a yellow cabinet wood.

San Juan or white mahogany is used for building.

Santa Maria is employed for bridge timbers and foundations, and for shipbuilding.

Sapodilla or sapotillo is used for general construction purposes.

Satinwood.

Tempisque.

Yema de huevo.

Zapote.

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NICARAGUA

Extent of Forests.—It is estimated that approximately 70 per cent of the total area of Nicaragua, or about 35,000 square miles (22,400,000 acres), is forested. This is 30 acres per inhabitant. The original forest area was somewhat greater, covering probably at least 90 per cent of the country. Clearing of forests for agricultural use is steadily, although not rapidly, going forward.

Character and Distribution of Forests.—The Atlantic or Caribbean side of the country is almost entirely covered with forest, and is sparsely populated. Large areas of low swampy land along the coast are covered with forests of mangrove, in a belt from 10 to 20 miles wide, and extending from 40 to 50 miles up some of the numerous streams. Belts of tropical jungle follow the streams inland, while on the higher ground between them are extensive pine savannas, which occupy most of the country east of the 84th meridian and north of the Rio Grande, an area of about 5,000 square miles. Considerable areas are covered with open stands of palms. The pine forests of this region are rather open, broken by numerous meadows, and the stands per acre are comparatively light. The species is slash pine (*Pinus heterophylla* or *P. cubensis*) or a closely related sub-tropical pine. The soil is very sandy.

Farther inland the topography is more rolling and the soil better, and the forest is a dense tropical evergreen forest, containing mahogany, Spanish cedar, ceiba, genisero, ñispero, pochote, rubber, laurel, and hundreds of other species. Much cedar and mahogany have been cut from this region, especially along the rivers nearer the coast. Above this foothill region, in the higher mountains, the tropical forest gradually gives way to a temperate forest of oaks and pines, of which there are several species. These forests are very extensive, and the timber is of better quality than the pine near the coast. Extending fo.. some distance down the western slopes, the pine gradually drops out, leaving oaks, liquidambar, and other hardwoods, and these finally give way to chaparral and open plains, dotted with trees scattered singly or in groves. The climate here is dry during several months of the year, and the trees shed their leaves during the dry season. Guayacan, fustic, brazilwood, jicaro, and various leguminous trees are among the more common species.

The lowlands on the western coast are partly open plains and partly covered with tropical forest, composed of numerous valuable species, such as pochote, guacimo, guanacaste, elequeme, madroño, jocote, and others. Mangroves occur along the bays and river mouths, and groves of coconut palms are not uncommon.

Ownership of Forests.—A very large proportion of the forest lands of Nicaragua still belongs to the state. This is especially true of the thinly populated eastern part of the country, where most of the forests

are located. Definite figures as to the division of ownership are lacking. The government has had a rather liberal policy of disposing of its lands, selling them at prices ranging from 16 cents an acre for open grasslands to 40 cents an acre for watered agricultural lands. An extra charge of 50 cents an acre is added for the timber, where it is of economic value.

Annual Growth, Annual Cut, and Losses.—Data on these subjects are lacking. Growth is naturally fairly rapid, and doubtless keeps pace with the cutting on lands that are kept in forest. Mahogany is reported to reach merchantable size in 50 years. Since, however, so much of the forest is entirely unexploited, and therefore probably not increasing in volume at all, figures on the total growth would be of very little significance in judging the productivity of the forests. It is probable that there are considerable losses from fire in the pine forests, although no information on this point is available.

The cut of wood for domestic use is not very large, but considerable quantities of logs and some lumber are cut for export. The total lumber cut is probably not more than 12,000,000 board feet (1,000,000 cubic feet), while the cut of export material is at least as great and in some years greater. In addition, much timber is cut for fuel, fencing, and other uses, so that the total annual cut is probably not far from 10,000,000 cubic feet a year, principally hardwoods.

Imports and Exports.—Nicaragua uses very little imported lumber. Little or none is imported by the west coast, but the Atlantic coast towns have brought in some from the southeastern United States. Lumber imports during several recent years have been as follows: 1913, $37,575; 1914, $26,082; 1918, $3,286 (87,000 board feet); 1919, $17,844 (257,000 board feet); 1920, $55,089 (1,068,000 board feet). In addition small quantities of shooks and staves are imported, but the average total will hardly exceed 50,000 cubic feet. Southern yellow pine and cypress are practically the only species imported.

Timber exports, on the other hand, have been considerable for many years. Nicaraguan mahogany is of high quality, ranking after that from Cuba and Santo Domingo, and it began to be exported to Europe after the more accessible West Indian supplies became depleted. Even before that, large quantities of dyewoods (fustic or mora and brazilwood) were exported, principally to England and France. During the 4-year period 1881-1884, average annual exports were:

Mora (fustic)	22,507 tons
Brazilwood	168 tons
Cedar	1,376 M board feet
Mahogany	52 M board feet
Genizaro	16 M board feet

This is equivalent to approximately 1,000,000 cubic feet. During 1913 and 1914 the average exports amounted to:

Dyewoods	3,382 tons
Cedar	342 M board feet
Genizaro	366 M board feet
Mahogany	8,124 M board feet
Nambaro (rosewood)	1,182 M board feet

The total amount is equivalent to about 1,000,000 cubic feet, valued at $416,000. With the outbreak of the world war there was a temporary increase in production of mahogany, wood exports in 1917 amounting to over $1,300,000 in value, nearly all mahogany, with small quantities of cedar, nambar, genizaro, guayacan, and dyewoods. The quantity was probably something over 21,500,000 board feet, or 1,800,000 cubic feet.

Exports to the United States in 1920 were 21,300,000 board feet, of which over 80 per cent was mahogany. Small quantities of yellow pine lumber were exported from the east coast for use on the Panama Canal, but the pine industry has not yet become established on a permanent basis.

Most of the timber exported is in the form of logs, which are subject to an export tax of from $1 to $4 per thousand board feet or per ton. The principal exporting port is Bluefields, on the Atlantic coast, while others of importance are Greytown (San Juan del Norte) and Gracias à Dios, on the Atlantic side, and Corinto and San Juan del Sur on the Pacific.

Domestic Consumption.—The domestic consumption of lumber is small, being wholly supplied by some 15 or 20 local sawmills, supplemented by a certain amount of hand-sawed material, except for the small quantities imported on the Atlantic coast. Not more than 12 million board feet, and probably less, is used in Nicaragua. Consumption of wood for fuel and fencing is much larger in the aggregate, amounting to perhaps 8,000,000 cubic feet. The total consumption of all timber is nearly 9,000,000 cubic feet, or 12 cubic feet per capita.

The Lumber and Wood-Using Industries.—The lumber industry has been very slow to develop in Nicaragua. The greatest handicap is lack of communication, either railroads or highways, which are almost entirely lacking in the eastern forest region. There are only about 200 miles of railroad in the entire country. Cedar and mahogany have been cut along the coast and the rivers, down which logs are floated during periods of high water, but little other lumbering has been done in this region. Although the coastal pine belt is traversed by a number of fairly large rivers, which are navigable for rafts of logs or light barges, aside from one or two small operations no attempt has been made to

lumber in this region. Practically all of the mahogany, cedar, and dyewoods are exported in the log. There are only about half a dozen sawmills in the eastern part of the country, and not all of them are operating.

The western slope has nearly all of the population, and local sawmills, about a dozen in all, supply the entire requirements for lumber, except such as is sawed by hand. Some export material is cut on this side. Logs are harder to get out, however, because the streams are small and cannot be driven as readily as those on the Atlantic side.

Wood-using industries are few. Most of the furniture used in the country is made in small local shops, which turn out products of excellent quality. The principal ways of travel and transportation, especially in the eastern region, are the numerous streams, and much wood is used in building boats. Some lumber is used in the manufacture of boxes and containers for various local products. The native wagon makers also use domestic woods.

Forest Legislation.—Little is known regarding Nicaragua's forest policy. Cutting of timber on the public domain is allowed without charge where it is to be used within the country; if exported or if cut and left in the woods, a tax of from $1 to $4 per ton or per 1,000 board feet is levied. Public forests may be either bought outright or leased at very low prices. That there is some idea of conserving the more valuable timber is shown by the requirement, in the case of at least one concessionaire, that two mahogany trees be planted for each one cut.

Secondary Forest Products.—Rubber was long one of the most important products of eastern Nicaragua, and at one time over 4,000 men were employed in the industry. Most of it comes from wild forest trees (*Castilloa elastica*), but a few plantations have been made. Forty years ago the average annual exportation of rubber was about 1,500,000 pounds. The industry here declined with the development of the plantations of the East Indies, and the average export during 1913-1914 was only 400,000 pounds.

The pine forests are a valuable potential source of turpentine and rosin, but the industry has not yet developed. A few small plants are operating near the Honduras border. Other gums, resins, and vegetable oils are produced in small quantities, and may become important products.

Dyewoods have been mentioned in the discussion of timber exports. Mangrove, which occupies large areas, has not been exploited to any extent. It may eventually become an important source of tanning material.

Probable Future.—With a large forest area and a comparatively small requirement for timber, Nicaragua may be expected to continue to export timber, and as soon as roads and railroads are built so as to

open up the forest region, the volume of exports will probably increase very greatly. The pine forests promise to become fairly important sources of naval stores, as the pine forests of the United States become unable to meet the demands for these products.

Woods of Nicaragua.—Among the several hundred trees of economic value native to Nicaragua, are the following:

TABLE 293.—IMPORTANT TREES OF NICARAGUA

Almendro is a valuable hardwood species of the eastern forests

Brazilwood is a fairly abundant dyewood species, found especially in the drier districts on the west side.

Carbon or palo de carbon is an abundant tree of medium size, excellent for posts and railroad ties.

Caoba or mahogany (*Swietenia* sp.) is still fairly abundant except close to the rivers, and is still cut in considerable quantity. It reaches large sizes, occasionally 10 feet or more in diameter.

Cedro (*Cedrela odorata*), which is scattered through the tropical forests with the mahogany, is more abundant. It also reaches very large sizes. It is widely used for construction and furniture, and much is exported.

Ceiba is a very large tree, occasionally reaching 14 feet in diameter and 70 feet of clear bole. The wood is soft, easy to work, and light in weight, and is much used for construction, canoes, and barrels. The tree also produces "silk-cotton."

Chaperno has durable wood, used for furniture and cabinet work.

Chilamate (*Ficus* sp.) is a common west slope tree.

Chiquirin has durable wood, used for various purposes, especially for ties.

Coconut palm is abundant near the coasts.

Cortez is a large tree with heavy, durable wood, used for house framing and cabinet work.

Coyol and corozo or cohune are palms, of value for their nuts and for various purposes.

Coyote is valuable for ties.

Elequeme (*Erythrina coralodendron*) is a valuable tree of the western slope. It is a source of dye.

Espino occurs in the west.

Fustic, mora, or moran (*Chlorophora tinctoria*) yields a very valuable dyewood, which has long been an important article of commerce. It is most common on the western slope. The wood is used for construction.

Genisero, jenisero, or genisaro is a large tree with wood somewhat resembling cedar and mahogany, and makes excellent lumber. It is used also in building vehicles.

Granadillo is a fairly abundant tree, yielding cabinet wood of excellent quality, used for interior decoration.

Guabillo (*Inga* sp.) is common in the west.

Guachipilin is used for ties and telephone poles. The wood is durable in moist situations.

Guacimo (*Guazuma ulmifolia*) is a common western tree.

Guanacaste (*Enterolobium cyclocarpum*) is a hard cabinet wood species, common on the western slope.

Guapinol furnishes good construction and cabinet wood. It is used also for sugar mill rollers.

Guarumo (*Cecropia insignis*) is a common tree in the west. It has soft, perishable wood.

Guayabo de monte is a medium-sized tree, used for masts.

Guayacan or lignum vitae (*Guaiacum* sp.) is exported in small quantities.

Guiliguiste is used for ties and interior finish.

TABLE 293.—IMPORTANT TREES OF NICARAGUA—*Continued*

Jicaro or sacaguacal (*Crescentia cujete*) is a small tree of the drier western districts, the wood of which is used for boat knees, saddle-making, and other purposes.

Jocote (*Spondias lutea*) is a large tree of the western lowlands. It has rather soft wood.

Jocote or hocote (*Pinus teocote*) grows in the higher mountains. It is a yellow pine with a fairly high resin content.

Lagarto is a valuable tree of the east coast.

Laurel is a rather small tree, used for house frames.

Lligualtil is a small tree used for making hoops and canes.

Madera negra or madre de cacao has a very durable black wood. It is used for posts, ties, foundations, and other purposes. Its growth is very rapid.

Madrono (*Calycophyllum candidissimum*) furnishes a good substitute for boxwood, used for cabinet work.

Mangle or mangrove (*Rhizophora mangle* and others) is abundant on both Atlantic and Pacific coasts.

Nacascalo or dividi reaches large diameters, but is rather short. It is used for ties.

Nance or nancite (*Malphigia punicifolia*) is a small tree whose bark is used for tanning.

Nambaro or rosewood is a fairly abundant tree, yielding cabinet wood.

Nispero is a large hardwood tree, used for posts, bridges, wharves, and construction, and also valuable for its fruit.

Ojo tostada has tough, elastic wood.

Palo de arco is used for construction.

Piedra has very hard, heavy wood, used for furniture, beams, and pillars.

Plomo and posan occur in the eastern tropical forests.

Pochote (*Bombax macrocarpum*) has wood somewhat like cedar, but softer. The tree reaches very large sizes. The lumber is widely used for flooring, siding, and shingles. Like cedro, it resists termites.

Quiebra-hacha is a common tree of average size, with very hard, durable wood, used for poles, posts, ties, and cabinet work.

Quita calson is abundant in the coastal region, and is used for boards and interior work.

Roble includes several species of true oaks, which occur at the higher altitudes. Some of these are excellent timber trees.

Ron-ron is a common large tree of the eastern region. It furnishes an excellent cabinet wood.

Sandal yields dyewood.

Tempisque is a large hardwood species, useful for cabinet work.

Tiguilote is a medium-sized tree, used in carriage building.

Zapotillo and zopilote are not much used. The first is reported to resist teredo attacks.

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PANAMA

Extent of Forests.—Eighty-six per cent of the surface of Panama, or 27,850 square miles, is wooded. Of this, however, about one-third is open, lightly wooded country called "montes," and only about 60 per cent of the total area, or 19,400 square miles (12,400,000 acres) is productive timber forest. This is 27.5 acres per inhabitant. Little of the original forest has been cleared, except in the vicinity of the Canal and on scattered plantations. Clearing is proceeding very slowly at the present time.

Character and Distribution of the Forests.—The Atlantic side of the country is practically all covered with forest, except for a few small clearings for settlements and plantations. On the Pacific side, the Darien region southeast of the Canal, the peninsula of Veraguas and Los Santos, and the higher mountains are covered with timber, while most of the rest of the slope is open park or savanna, with only scattered trees. The Atlantic forest and that of the interior of Darien are evergreen tropical forests, while nearer the coast of Darien are the so-called "monsoon" forests, which lose their foliage during the dry season. There is a coastal belt of mangrove along much of the Pacific coast. It is most extensive in the Darien region, where it extends as much as 20 miles inland up the Bayano River. Some of the islands, notably Coiba, southwest of Veraguas, are heavily timbered.

About 900 tree species, including 50 genera of *Leguminosae,* have been listed as native of Panama. There are no conifers, but some of the broadleaf trees have very soft, light wood. The greatest number of species occurs in the evergreen forest, while the deciduous forest has fewer, and the mangrove belt is comparatively simple in composition.

The forests in the drier districts are more or less open, with rather short trees, but they contain much timber of economic value. The evergreen forests are very dense, with many large, tall trees running from 2 to 6 feet in diameter, and from 100 to 150 or more in height. Occasional individual trees are reported to contain as much as 10,000 board feet and stands of 10,000 to 20,000 board feet (approximately 2,000 to 4,500 cubic feet) per acre occur over extensive tracts, with small areas containing as much as 40,000 board feet (nearly 9,000 cubic feet) per acre. The trees are arranged in several stories, as in the other tropical forests of South America, and the undergrowth is dense.

Among the most abundant trees are:

TABLE 294.—MOST ABUNDANT TREES OF PANAMA

Espave—*Anacardium rhinocarpus.*
Cedro espinosa—*Bombax fendleri.*
Cedro amargo—*Cedrela glaziovii puberula.*
Cuipo.
Coratu—*Enterolobium cyclocarpum.*
Laurel—*Cordia gerascanthus.*
Santa Maria or calaba—*Calophyllum calaba.*
Guayacan—*Tecoma chrysantha* or *Tabebuia* sp.
Caoba—*Guarea caoba, Carapa guianensis,* and *Swietenia mahagoni.*
Roble—Several species of *Quercus.*
Bongo.
Nispero—*Dipholis* sp.
Mangle—*Rhizophora mangle* and others.
Amarillo—*Centrolobium* sp., and others.
Balsamo.
Almendra—*Haemocharia* sp.
Alcornoque—*Dimorphandra megistosperma.*
Cativo.

Cruises of one large tract indicate the following species: espave, 50 per cent, running from 2 to 6 feet in diameter; cedro, especially cedro espinosa, 30 per cent, from 2½ feet up in diameter; roble, 10 per cent, from 2 to 4 feet; other hardwoods, 10 per cent, from 1½ to 4 feet.

There are no estimates of the total amount of standing timber in Panama. The supplies of a few kinds have been estimated very roughly as follows: Caoba (3 kinds), 2 billion board feet; espave, 1.6 billion board feet; laurel, 1 billion board feet.

Character of Ownership.—Practically all of the forest land in Panama is still in public ownership, as it is the policy not to alienate such lands except for purposes of colonization and development. Concessions are granted to individuals and corporations, in order to encourage development, but these are practically leases which do not carry title to the land. No figures are available as to the amounts of land held by different classes of owners.

Annual Growth, Annual Cut, and Losses.—Data regarding these points are lacking. Practically the whole forest is in a virgin condition, except for limited areas of second growth near the Canal Zone. The net growth, therefore, must be comparatively small. Some of the important species make very rapid growth, and the potential growth rate of the forests, once they are exploited under management, is very great.

Very little cutting is being done, except for the limited local consumption. Probably much more wood is cut for fuel and charcoal and to make dugout canoes than is cut for lumber. Within the last five years some local timber has been cut for use of the Panama Canal; cross ties

for the local railroads have been cut for many years. A conservative estimate of the total cut of all classes of material is about 4,600,000 cubic feet a year, which is about ⅓ of a cubic foot per acre of forest.

Exports and Imports.—Exports of wood from Panama are relatively unimportant. Most of it goes to the United States, which took 2,200 and 2,800 tons in 1916 and 1917, respectively. These amounts represent approximately 110,000 and 140,000 cubic feet. The principal species exported are cocobola, cedar, mahogany, balsa, and lignum vitae. The value of wood exported in each year was a little more than $100,000.

In 1919, exports to the United States included 273,000 board feet of cedar, 504,000 feet of mahogany, 633,000 feet of other cabinet woods, and 25,000 feet of logs and lumber. In 1920, the corresponding figures were 231,000, 192,000, 570,000, and 295,000 feet. In the three years 1909, 1910, and 1911, Panama exported in round numbers, 1,800, 1,200, and 1,550 metric tons of cocobola, of which the United States took 85 to 93 per cent, Germany 5 to 7 per cent, and France and the United Kingdom together 2 to 8 per cent.

Most of the construction lumber used in Panama is imported. It was formerly about half southern yellow pine and half white pine, but now consists of yellow pine and Douglas fir. Few hardwoods are imported, except that the Canal has brought in considerable hardwood for railroad ties and construction. Practically all the imported lumber comes from the United States, except for some hardwoods, such as greenheart, used in the Canal work. Imports from the United States have been as follows:

TABLE 295.—IMPORTS OF LUMBER, PANAMA

Kind of product	Average, fiscal years 1909 to 1914	Average, calendar years 1919 and 1920
Timbers and lumber	45,675 M board feet	22,750 M board feet
Other material (logs, railroad ties, shingles, staves, shooks, etc., estimated on basis of quantities and values given)	470,000 cubic feet	40,000 cubic feet

The total importations of wood from the United States have dropped from approximately 4,275,000 cubic feet per annum before 1914 to 1,940,000 cubic feet. In 1913, and again in 1919, the value of lumber and other wood products imported from the United States was a little over $1,000,000 and in 1920 it reached $1,400,000. The normal importation will, doubtless, be very much less as the construction work on the Canal is brought to a conclusion.

Domestic Consumption.—Aside from the Canal Zone and the railroads, consumption of wood in Panama is very small. The use of wood in buildings in the larger cities is restricted, because of the danger of fire, and housing conditions in the country districts are, in general, very primitive. There are almost no wood-using industries. Most of the native wood that is cut is used for firewood and charcoal. The total consumption of wood is estimated to be 6,400,000 cubic feet a year, or 14.3 cubic feet per capita.

Forest Management and Forestry Laws.—Little is known regarding the forest policy of Panama. According to the laws of 1913, all lands not held legally by private individuals or as town grants are the property of the nation, which can grant them to settlers and to corporations to promote development of the country, or sell them outright. Wherever the lands contain large quantities of timber, so that their sale would be prejudicial to the public interest, concessions may be granted, in areas not to exceed 12,500 acres (5,000 hectares) per person or company. These concessions give the right to cut timber, under certain restrictions, and the grantee pays a fixed rental besides a share in gross or net receipts. He must agree not to cut immature trees needlessly, and his operations are subject to inspection by the government. Except for domestic use, products may not be removed from the national forests without a permit. Strips of forest must be left standing along public roads and streams and around stream sources.

The Lumber and Wood-Using Industries.—Very little lumbering is done in Panama. The natives cut by hand what little wood they use, and in 1913 there were only about half a dozen sawmills in the Republic. There are probably more now, because during the war an effort was made to develop local timber resources for use of the Canal Zone, and considerable timber of a dozen or more species was cut and used. As long ago as 1910, an American company planned to operate a sawmill of 75,000 board feet daily capacity on a concession it had obtained. Whether or not the plan was put into effect is not known. Perhaps the greatest difficulty in the way of the lumber industry has been lack of transportation.

Wood-using industries are of very minor importance. The building and repair of boats is relatively one of the more important ones, and some furniture is made from local woods.

Minor Forest Products.—Important products of the Panama forests are balata, of which $466,000 worth was exported to the United States in 1916, and tagua nuts (*Phytelephas macrocarpa*), exported to the United States to the value of $185,000 in the same year. The average exportation of tagua nuts to the United States for several years before the war was about 2,500 tons. Mangroves and several other species are potential sources of tannin, but are not yet much developed. Rubber

(from *Castilloa elastica*) is exploited in small quantities. Previous to the war chicle was exported in very small quantities, but in 1919 and 1920 the exports rose to 24,600 and 20,900 pounds. In the same years, 206 and 135 tons of dyewood were shipped to the United States. A few pounds of cinchona bark are exported.

The Probable Future.—It is probable that her forests will eventually become one of Panama's most valuable resources. Although large areas now forested are of great potential value for agriculture, others are not but will produce timber at a rapid rate. As soon as good roads and railroads are built into the forests, so that the timber can be taken out at fairly low cost, it is reasonable to suppose that markets will develop adequate to consume all that may be cut. Many of the local woods are not attacked by termites, which gives them an important advantage over the imported material. The west coast of South America, south of Ecuador, will require increasing quantities of timber for mining and railroad development. This is particularly true of Peru and Bolivia, whose forests on the headwaters of the Amazon River are inaccessible to the western mining districts, and of northern Chile. Panama, because of the Canal, is especially favorably situated for competing in these markets, as well as for shipping cabinet woods and other products to the United States and Europe.

Woods of Panama.—Among the 900 or so species of trees that occur in the Republic are the following:

TABLE 296.—IMPORTANT TREES, PANAMA

Aguacate colorado (*Persea gratissima* or *P. americana*), has whitish, hard, tough, coarse-grained wood, used for various purposes. It is most valuable for its fruit.

Alazano (*Calycophyllum candidissimum*), has even-grained, hard wood, used for canes and umbrella handles.

Alcareto averages from 30 to 36 inches in diameter, and from 120 to 140 feet in height The wood has been used on the Canal for car and vehicle construction in place of white oak. It weighs 59 pounds per cubic foot when dry.

Alcavu or alcabu reaches 30 inches diameter and 100 feet height. Its brownish wood, weighing 31 pounds per cubic foot, is a satisfactory substitute for yellow poplar, for sash, doors, and siding. It has been used on the Canal.

Alcornoque or alcornoco (*Dimorphandra megistosperma*) is a large tree, whose tough, close-grained wood resembles ash, and is put to similar uses. It is also used for furniture. It is a good oak substitute, and is very durable under water.

Alfagia, alfajia, alfajulia, or alfahillo, has hard wood, valuable for making furniture. The tree is rather small.

Algarrobo (*Hymenaea courbaril*), a very abundant tree, has durable, hard, strong, reddish-brown wood, excellent for cabinet work and furniture.

Almendra (*Haemocharia* sp.) furnishes one of the best construction woods. The tree reaches diameters of 5 feet and heights of 140 feet, and is abundant in certain districts. The wood weighs 65 pounds to the cubic foot, being somewhat heavier and also stronger than oak. It is used for ship building and hydraulic construction, and is reported to resist the attacks of teredo.

TABLE 296.—IMPORTANT TREES, PANAMA—*Continued*

Amargo (a legume) is a large, well-formed tree, similar in size to almendra. Its wood weighs 59 pounds per cubic foot, and is excellent for ship and boat building and general construction.

Amarillo de calabazuelo is a common, large tree with hard, heavy, greenish wood, used for interior finish.

Amarillo de frio is a common tree with hard, heavy, tough, fine-grained, yellowish wood which is durable and takes a fine polish.

Amarillo de Guayaquil (*Centrolobium pattinense*) has hard, fine-grained, red-streaked wood, used for cabinet work.

Balsa (*Ochroma lagopus*) is the corkwood, widely used for floats, rafts, life-preservers, and other uses. It weighs about 8 pounds per cubic foot.

Balsamo is a widely distributed tree with dark colored wood which finishes well and is excellent for cabinet work.

Barragon is a common softwood species.

Batteo is a large tree belonging to the same family as mahogany. Its wood, which weighs 34 pounds per cubic foot, is used on the Canal for general construction and interior finish.

Berba (*Brosimum* sp.) has hard, yellow wood which polishes well.

Bola furnishes construction wood.

Bongo or bonga is a very common large tree, reaching 10 feet in diameter and 160 feet in height. Its wood is soft, and used principally for making dugout canoes.

Brazilwood (*Haematoxylon braziletto*), a source of red dye, is reported to occur in Panama.

Cabresto has rich red wood that resists insects and takes a fine polish. It is used for furniture and finish.

Cacique or macano (*Eugenia lepidota*) is a comparatively small tree, whose wood is valuable for cabinet work and canes and is also used in ship building. It is durable in the soil and in water. The wood is hard and tough, and yellowish in color, becoming red when seasoned.

Caimito (*Chrysophyllum cainito*) furnishes good construction wood which polishes well.

Caimitillo (*Bumelia obovata*) is a common tree with wood slightly resembling birch. It finishes well.

Cañafistula (*Cassia brasiliana*) has close-grained yellow wood that finishes well.

Cana blanca is a cane used for lath.

Calienta vieja has hard, heavy, brownish wood, which finishes well.

Caoba includes true mahogany (*Swietenia mahagoni* or a closely related species), the crabwood of Guiana (*Carapa guianensis*) which more or less resembles mahogany, and caoba blanca (*Guarea caoba*), which is similar in appearance. The last species is especially abundant, and reaches fairly large size. The wood weighs 34 pounds to the cubic foot. Until 1917 it was not utilized, but since then has been used on the Canal for siding, panels, car finish, sash, doors, and similar purposes.

Caracolito is a dyewood.

Carbonero (*Oncoba laurina*) has hard, heavy, yellowish-brown wood, used for interior finish. It is not abundant.

Carreto (*Aspidosperma* sp. ?) has hard, yellow wood that takes a smooth finish.

Cativo or captivo is a very tall tree, furnishing a large proportion of clear lumber almost as soft as sugar pine.

Cedro includes several species, such as cedro amargo, cedro cebollo, cedro bueno, cedro espinosa, cedro macho, cedro grenadino, cedro tangari, and cedro papaya or passaya.

Cedro amargo (*Cedrela glaziovii puberula*) reaches large sizes, has light, fairly soft, strong wood, weighing only 29 pounds per cubic foot, which is valuable for interior finish, furniture, boat building, and cigar boxes.

TABLE 296.—IMPORTANT TREES, PANAMA—*Continued*

Cedro espinosa (*Bombax fendleri*) is an important species, with hard, dark colored wood, and the supply is fairly large. It is used for lumber and furniture.

Cedro papaya (*Carica papaya*) has light wood said to slightly resemble a soft pine. The others are used as mahogany substitutes to a limited extent.

Cedro macho (*Guarea longipetiola*) resembles cedro amargo, but finishes better and is widely used for interior finish.

Ceiba (*Eriodendron anfractuosum*, var. *caribaeum*) has soft, light wood used for cheap lumber.

Cerezo (*Malphigia glabra*) is used for building.

Cigua has wood somewhat like hickory, and used for similar purposes, and also for cabinet work and interior finish.

Chachojo and chuchipate are used for furniture.

Chalote has white wood with brown stains. It is used for furniture.

Cocobola (*Dalbergia retusa*) yields hard, durable, cabinet wood, with figured grain. It is used for handles and is exported to the United States to some extent. Some of the trees are very large.

Copaiba (*Copaifera officinalis*) is an abundant tree with hard, heavy wood, used in shipbuilding and construction.

Cope is an abundant wood, but rather inferior for construction.

Coratu or corotu (*Enterolobium cyclocarpum*) is a large, tall tree, with light, fairly soft wood resembling that of espave, or sometimes that of walnut, and used for general construction and shipbuilding.

Crepo is a common tree with soft wood.

Cuajado (*Vitex floridula*) has hard, greenish-tinged yellow wood, which takes a fine polish.

Cuchillito has very hard, ornamental wood. The tree is not common.

Cuipo or quipo is a very common large tree, with fairly soft, light wood, which may be suitable for pulp. It is used for dugout canoes.

Currucai is of some commercial value.

Curtidor (*Weinmannia* sp. ?) and divi-divi (*Caesalpinia coriaria*) are sources of tannin.

Ebano yields cabinet wood.

Ebo is a large tree used for boats.

Espave (*Anacardium rhinocarpus*) is the same as caracoli of Colombia and mijao of Venezuela. It is one of the most important and abundant trees of Panama, forming 50 per cent or more of the stand in some localities. Trees occasionally reach diameters of 6 feet. The wood is light, weighing only 34 pounds per cubic foot, easy to work, fairly strong, and durable. It is not especially good for construction, though it has been so used. It is excellent, however, for ceiling, siding, panels, wainscoting, and the like, and is extensively used for these purposes and for boats. Care must be taken in seasoning to prevent excessive checking. It resembles mahogany in some respects.

Espino amarillo (*Xanthoxylum spinosum*) is used for hydraulic construction.

Frijolillo is suitable for furniture. Its wood resembles guayacan.

Fustic or mora (*Chlorophora tinctoria*) often reaches 3 feet in diameter. Its hard, yellow wood is valuable for dye.

Gasparillo (*Aulacocarpus sp.*) has tough, hard, durable, reddish-brown wood used for canes.

Gorgojo (*Miconia sp.*) reaches diameters of more than 2 feet. Its wood, resembling white oak, is used for furniture and interior finish.

TABLE 296.—IMPORTANT TREES, PANAMA—*Continued*

Guachapeli or gachapela has wood similar to oak. It is durable in the soil and is used for furniture.

Guayabo de montana is a rather small tree with hard, heavy, close-grained wood, used for canes.

Guayacan (*Tabebuia guaiacan*) has very hard, heavy, strong, durable wood, excellent for heavy construction and as a substitute for true lignum vitae. It is used extensively. It weighs 76 pounds per cubic foot, dry. Trees reach diameters of 4 feet and heights of 130 feet.

Another guayacan (*Tecoma chrysantha*) is considerably smaller, seldom exceeding 2 feet in diameter or 70 feet in height, and is much less abundant than the other.

Hobo or jobo (*Spondias lutea*) is a very large tree.

Hoharyor hoharay (possibly *Hura crepitans* ?) is a large, tall tree with soft, pinkish wood, weighing 34 pounds to the cubic foot. It probably is suitable for pulp and for light construction and boxes. It more or less resembles basswood or poplar. It is reported to occur in almost pure dense stands in Chiriqui Province.

Hueso is used for construction.

Huesito (*Faramea occidentalis*) is a rather small tree with very hard, durable, yellow wood, which is used for canes and umbrella handles.

Igua is a dyewood.

Jagua rosada (*Genipa sp.*) reaches diameters of from 1½ to 4 feet. Its wood is heavy, tough, close-grained, works fairly well, and is used for furniture and building.

Jicarillo furnishes construction material.

Jiqua blanca and jiqua negra are furniture woods.

Laurel, Spanish elm or rosewood (*Cordia gerascanthus*) is a common tree, with rather soft, light colored wood; used for construction and piling. It reaches 3 feet in diameter, and 100 feet in height.

Logwood (*Haematoxylon campechianum*), valuable for its dye, is reported to occur in Panama.

Macano (*Diphisia carthaginensis*) occasionally reaches a diameter of 40 inches. Its hard, light yellow wood polishes well, and is durable in damp situations.

Madroña or madroño is a comparatively small tree, whose hard wood is used in building.

Majagua is used for furniture.

Malvicino is an abundant large tree with yellow hard wood, much used in building.

Mamey (*Mammea americana*) is most valuable for its fruit. Its hard, tough, close-grained wood slightly resembles cherry.

Mangle caballero, mangle colorado, or salado (*Rhizophora mangle*), mangle pinuelo *Conocarpus erectus*), mangle blanco or bobo (*Avicennia nitida*), and mangle maringolo are sources of tannin as well as of building material and piling. Some of them also furnish spokes and handles. Over a million mangrove crossties for the Canal Zone were cut in the Bayano River region. Ties of mangrove last for 12 years. The mangroves make excellent wood fuel and charcoal.

Manzanillo (*Hippomane mancinella*) is used for building and cabinet work.

Mapurito yields a high-class cabinet wood with beautiful grain.

Marfil vegetal or anta (*Phytelephas macrocarpa*) is the tagua palm whose nuts are exported for vegetable ivory.

Maria, santa maria, or calaba (*Calophyllum calaba*) is a large tree, occasionally reaching 5 feet in diameter and 160 feet in height. Its wood is light and soft, weighing 30 pounds to the cubic foot, and has been used on the Canal for general construction, car-decking, panels, and cabinet work; and also for telephone and telegraph poles.

Marinjinto has heavy wood, used for sugar mill rollers.

Mascerno is used for furniture.

TABLE 296.—IMPORTANT TREES, PANAMA—*Continued*

Membrillo (*Gustavia angustifolia*) is a medium sized tree, with durable wood, used in building.

Mora (*Dimorphandra excelsa*) is used in construction.

Muquera is a source of dye or tannin.

Naranjito or naranjillo is used for spokes, tool-handles, and where great strength and toughness are required.

Nazareno (*Peltogyne purpurea*) furnishes cabinet wood. It is very hard, with light-colored sapwood and purple heart.

Nispero (*Dipholis* sp. ?), also called bullet tree, is one of the most valuable and abundant species. Its wood is hard, durable as teak, and somewhat like cherry in appearance. It weighs 79 pounds to the cubic foot. It is used for heavy construction and makes excellent cross ties. It yields balata gum, and is also valued for its fruit.

Nogalon (*Juglans* sp. ?) is a large tree, whose wood, weighing 62 pounds per cubic foot, is used in the Canal Zone for panels. It reaches large diameters, but is rather short and apt to be crooked.

Panama is a white wood, used for boards.

Peronil (*Ormosia panamensis*) has durable wood, used for building.

Ponulo has fairly soft wood, weighing only 34 pounds per cubic foot. It is used for car-staking, boxes and cheap lumber.

Quira or quera (*Platymiscium polystachyum*) has black and red wood somewhat similar to cocobola, and used extensively. The tree occasionally reaches a diameter of 4 feet.

Rasca (*Licania arborea*) has durable wood used for building.

Roble (*Quercus bumelioides*, *Q. seemanni*, and *Q. warszewiczii*) includes black, white and yellow oaks. The wood weighs 49 pounds per cubic foot, and is used for carpentry, furniture and staves. The oaks occur in Veraguas Province. *Tabebuia pentaphylla* is also called roble. It has very durable wood used for ship timbers.

Rosilla furnishes durable construction wood.

Sangre de drago has dense, tough wood related to lignum vitae.

Sangre or palo de sangre yields hard cabinet and furniture wood. It is abundant.

Sapodilla (*Achras sapota*) is somewhat similar to ñispero, but the tree is smaller.

Saponario and tanjiro are furniture woods.

Siete cueros has hard, heavy, durable, close-grained wood.

Soro is used for cabinet work and furniture.

Tamarindo de monte has rich, yellow wood that finishes well.

Tangare has heavy, light-brown wood. It is not common.

Terciopelo (*Sloanea quadrivalvis*) is a fair-sized tree, useful for timber.

Topaliza has rich, yellow wood, used for canes.

Torro yields cabinet wood.

Totuna is used for spokes and other purposes for which hickory is used in the United States. Trees are small.

Uvilla furnishes tannin.

Yaya or yalla (*Guatteria schomburgkiana*) is a medium-sized tree with durable hard wood, used for building and furniture.

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EL SALVADOR

Extent of Forests.—The area of productive forest in El Salvador is approximately 925,000 acres, which is 17.8 per cent of the total land area (8,130 square miles) and 0.7 acre per capita. This is the smallest per capita forest area of any country of South or Central America, except that of Uruguay, which is about the same. A great deal of the original forest, which was considerably larger, has been cleared away to make room for agriculture.

Character and Distribution of Forests.—Along the coast and extending short distances inland at the mouths of the rivers is a belt of mangrove forest. Farther back there are considerable districts, whose climate is rather dry during much of the year, with the open savanna vegetation typical of the Pacific slope of several other Central American republics. Characteristic species are fustic (or mora), "quebracho" (a hard wood, not to be confused with South American quebracho), ebano (a wood resembling ebony), and lignum vitae. Following the valleys, and in other districts which receive more rainfall, is a tropical forest containing many valuable hardwoods, including mahogany (*Swietenia*), Spanish cedar (*Cedrela*), rosewood, granadilla, laurel, cacao, zapotillo, conocaste, guachilipin, rubber tree, and balsam. Balsam (*Myrospermum salvatorense* or *M. sonsonatense*) is practically confined to a strip averaging about 15 miles wide along the coast between Acajutla and La Libertad, a distance of about 40 miles. This district is known as the "Balsam Coast." In the higher mountains of the inte-

rior the climate is cooler and the forest is one of the temperate region, with several kinds of pines, oaks, and walnut, as well as other species.

Character of Ownership.—Practically none of the forest land in El Salvador belongs to the state, it all having been alienated many years ago. Small areas are yet under control of municipalities. While there are many small holdings, a considerable part of the total area is held in comparatively large tracts. There are not many large continuous tracts of forest, because it has been much broken up by clearings.

Annual Growth, Annual Cut, and Losses.—Data on these points are lacking. Since, however, Salvador uses considerable quantities of wood and imports but little, it is likely that the annual cut is practically as great if not greater than the annual growth. The forests of the drier type, as well as the temperate pine and oak forests, are subject to more or less damage from fires. The total cut must be approximately the same as the domestic consumption of wood, which is at least 26,700,000 cubic feet and possibly more. This is 28.9 cubic feet per acre of forest.

Exports and Imports.—Neither exports nor imports of lumber cut very much figure in the commerce of El Salvador. Thirty years ago the imports, chiefly from California, amounted to about 750,000 board feet, or 62,500 cubic feet. Then high import duties resulted in a decline from even that small quantity. Since the end of the war imports have increased, reaching 1,450,000 board feet in 1919 and 2,140,000 board feet in 1920, of which from 80 to 90 per cent was redwood and the rest Douglas fir and a little white and yellow pine.

In 1909 exports of wood, consisting of mahogany, Spanish cedar, and fustic (or mora), amounted to only 259 tons, or approximately 12,500 cubic feet. In 1920 Salvador exported 825 tons of dyewoods and 16,000 board feet of timber, or about 26,000 cubic feet in all, to the United States.

Domestic Consumption.—The consumption of wood in El Salvador is relatively large. On account of the frequent earthquakes houses are usually built of wood, and they have to be replaced on the average every 20 years because of decay, termites, fires, or other destructive agencies. Wood is the principal fuel used in the country for domestic purposes, either in the rough form or as charcoal. Most of the wooden products used in the country are of domestic manufacture, from native woods. There are about 240 miles of railroads, which use wooden ties and considerable timber for construction purposes. Altogether the consumption must be close to 20 cubic feet per capita, or 26,700,000 cubic feet altogether.

The Lumber and Wood-Using Industries.—There are several saw and planing mills which supply most of the domestic requirements for lumber, probably amounting to 25 to 35 million board feet a year. Much

of the "millwork" for the houses of the better class is finished by hand, from the rough lumber. High import duties have been imposed in order to foster domestic wood-working industries, with the result that these industries are developed on a scale adequate to supply home requirements. Furniture, cabinet-work, and woodcarving of very fine quality are produced from native woods.

Forestry Legislation.—As El Salvador is primarily an agricultural country and the importance of maintaining forest cover, both to regulate the flow of streams and prevent erosion and to afford adequate supplies of timber, is appreciated, the agrarian law of 1907 was enacted to provide for perpetuation of her forests. Even though most of the forests are in private hands, they may not be cleared in whole or in part without a permit from the local authorities, nor may any trees be cut even for fuel except according to regulations.

Applications to clear land must state just where it is and how much is to be cleared. Permission will not be given where the maintenance of forest cover is deemed necessary for protection of slopes, preventing erosion, protecting sources of streams, holding dunes and shore lines, national defense, or safeguarding the public health. Fines are imposed for violations of the law and, in addition, the area must be replanted within two months.

Cutting in forests which may not be cleared must be done in such a way as to leave a continuous stand. Only the larger trees may be cut, and they must be replaced with trees of the same or better species within one year, at the season which promises the best chance for survival. Exempted from both of these provisions are small groves around buildings and other tracts under 3 hectares (7.4 acres) in extent, unless they are on mountain slopes or crests or around springs.

Every person owning more than 45 hectares (111 acres) of land must establish a woodlot (or complete one already existing in part) at the rate of 1 hectare for each 50 hectares owned. He may plant any useful species, but is supposed to give preference to such as will produce construction material or cabinet wood. Lands not suited to tree growth, and lands entirely utilized in a more productive way, are exempt from this requirement.

May 3 is fixed as the national Arbor Day (Fiesta de los Arboles), when every adult person is supposed to plant at least one tree, which he is to care for through the dry seasons until it becomes established. All local agricultural authorities are to establish nurseries of certain specified economically important species, to supply planting stock for this occasion.

The enforcement of the law is left to the rural inspectors, and it is

the duty of the local governments (municipalities) to prevent burning of the forests or their clearing in violation of the law.

Secondary Forest Products.—One of the most distinctive Salvadorean products, although not very large in quantity or value, is the so-called Peruvian balsam, which is the resin of *Myrospermum salvatorense* (or *M. sonsonatense*), also called hoitziloxitl. This product was first sent to Europe by the Spaniards. In 1896 more than 45 metric tons, worth over $900,000, was exported. By 1914 exports had fallen to about $80,000 in value, of which the United States took 44 per cent, Germany 39 per cent, France 9 per cent, and various other countries minor amounts. During 1919 and 1920 the average export of balsam to the United States alone exceeded 80,000 pounds, valued at $230,000. The balsam is used for making various medicinal preparations. The tree reaches fairly large size, and its hard, durable, dark-colored wood is excellent for construction and cabinet work.

Rubber is collected in small quantities from wild trees. None is from cultivated trees. The total exports of rubber in 1913 were valued at $19,000, and in 1914 they amounted to $5,600, going to Germany and the United States.

Tanbark for local use is secured from the coastal mangrove belt.

The Probable Future.—El Salvador will never produce more wood than is needed for domestic consumption. Limited amounts of cabinet woods and other woods for special uses will be exported in the future as in the past, but they will probably be more than offset by the importation of construction timber. The forest area is not likely to increase very much nor, on the other hand, will it be greatly reduced by further clearing for agriculture. Its productivity may be increased considerably by proper management.

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MEXICO

Extent of Forests.—The area of forests in Mexico has been variously estimated at from 20 to 140 million acres. Comparatively recent

estimates by the Mexican Forest Service indicate that there is about 49,400,000 acres (200,000 square kilometers) of timber forest, and 24,700,000 acres of woodland and chaparral. The timber forest comprises 10 per cent and the entire wooded area 15.1 per cent of the total land area. There are 3.2 acres of timber forest and 4.8 acres of all forest land per inhabitant.

It is stated that at the time of the Conquest forests covered a much greater area, and even then were being cut into heavily in densely populated regions, such as the valley of Mexico, which had more inhabitants then than it has now. Both under the Spanish rule and since it came to a close, forest destruction went on at a steadily increasing rate. In the past few years it has slowed down, however, and considerable areas are reported to be restocking naturally with forest growth, where they have been left to themselves. In all, about 370 million acres out of the total area of 491 million acres, is reported to be unsuited to agricultural use, and 123 million acres is incapable of growing timber or firewood. The other 247 million acres, however, can be made to produce either forest growth or scrubby woodland of value for fuel, posts, pasturage, and regulation of streamflow.

Distribution and Character of Forests.—Mexico extends in latitude from about 14° 30′ to about 32° 30′ north, a range of 1,250 miles, or almost as great as that of continental United States; and the range in longitude from eastern Yucatan to western Baja California is 30°, or almost 2,000 miles. The range in altitude is about 18,000 feet. As would be expected, there is great diversity in the character of forest. There are five principal types of forest vegetation, and many minor variations within each. Broadly speaking, they may be classified as: (1) forests of the desert and high plains region; (2) coastal forests; (3) evergreen tropical hardwood forests; (4) forests of the subtropical transition belt, between the tropical forests of the lowlands and the conifer forests of the higher mountains; and (5) conifer forests.

1. *Forests of the Desert and High Plains Regions.* Most of Baja California, western Sonora, eastern Chihuahua and Durango, northern Zacatecas and San Luis Potosi, practically all of Coahuila, and much of Nuevo León and Tamaulipas, have an exceedingly dry climate and very little timber forest. In many places the vegetation is of the desert type, consisting of cacti and various species of thorn shrubs. On many of the low, rolling hills, and especially on north slopes or in places where there is more or less moisture within reach of tree roots, are clumps or even extensive patches of low trees, principally mesquite, palo verde, huisache, peru or pirul, and scrub oak. In spite of their low stunted form, these trees are of great economic importance to the local population, as they furnish firewood, as well as fencing material, railroad ties, and much of

the wood used for construction. A little higher up the oaks are more numerous and often larger, and there are also some junipers and piñon pines, while on occasional high ranges there are open stands of Chihuahua and other pines. In the mountain canyons, and extending down into the lowlands along perennial streams, are narrow belts of such species as cottonwoods, willows, ash, elder, walnut, hackberry, sycamore, elm, cherry, hickories, acacias, and others. While some of these reach considerable size, in general they are rather short and of only local importance. The south central plateau region, extending southward to some distance beyond Mexico City, also has few trees except scrubby mesquite, acacias, and similar species.

2. *The Coastal Forests.* The coasts of Baja California, Sonora, and much of Sinaloa, on the Pacific side, and of most of Tamaulipas on the Gulf of Mexico, have very little forest, except for occasional groups of mesquite, palmetto, and other species, and lagoons where mangroves occur. Farther south, mangroves are more abundant, and there is a belt of tropical jungle, fairly wide in places, containing palms, mangroves, pochote, and various other species, as well as considerable bamboo. This forest, which is broken in many places by open areas of grassland or savanna, is not of great economic importance, although it contains some timber.

3. *The Evergreen Tropical Hardwood Forest.* From northern Vera Cruz southward on the Gulf side, and as far north as Central Sinaloa, on the west side, at elevations from a little above sea level up to 2,500 or 3,000 feet, is a dense tropical forest, similar to that of Central America and northern South America. It is composed of several hundred kinds of trees, mingled together in the greatest confusion, and is the forest which so far has contributed most to the foreign commerce of Mexico. Characteristic species are mahogany, Spanish cedar, granadillo, palo maria, guayacan, pochote, gateado, macayo, zapote mamey, zapote chico (the source of chicle), balsamo, coralillo, jicoco, logwood, brazilwood, fustic, amapa, ebano, haba, primavera, palo fierro, rubber (*Castilloa* and *Ficus*), corozo and other palms, and many other woods valuable for cabinet work or construction. Toward the north, on both coasts, this forest occupies only a narrow belt, but it widens out to the southward, and is of greatest extent and best quality east of the Isthmus of Tehuantepec. Some of the trees are very large, especially cedar and mahogany, which frequently have diameters of from 4 to 6 feet with heights to correspond. Although the better stands contain from 10,000 to 15,000 board feet per acre, including all species, individual species are so scattered that the stand per acre of any given kind is very light. The forests near the coasts and larger streams have nearly all been culled for cedar, mahogany, and a few other species of cabinet or dye-

woods, and in some sections much of the tropical forest has been cleared to make way for agricultural plantations, but there still remain large amounts of virgin timber farther back.

4. *The Subtropical Transition Forest.* Evergreen oaks are fairly common in the tropical forest; toward its upper limits they give way to deciduous oaks, and the other tropical hardwoods gradually drop out and are replaced by various deciduous species—liquidambar, cherry, sycamore, walnut, elm, and figs. The stands are more regular and composed of fewer species than in the tropical forest. Subtropical pines appear at 2,600 feet elevation, but are not common below about 4,000 feet. This forest occupies a belt above the tropical forest on both the east and west escarpments and extends up to about 7,000 or 7,500 feet, where the true Sierra Madre forest begins. It contains considerable timber of economic value, especially for local use.

5. *The Conifer Forests of the Mountains.* This is the most extensive and important forest region of the country, although it has hitherto remained largely undeveloped because of its location. Pines begin to be fairly numerous at 4,000 feet elevation, although oaks predominate up to about 7,000 feet. Above this the forests up to more than 10,000 feet elevation are characterized by the predominance of pines, of which there are numerous species, including both white and yellow pines. Some botanists put the number of species at more than 20. Some of these pines reach large sizes, with diameters of from 3 to 5 feet or more, and heights from 100 to 150 feet. Stands per acre range from 2,000 up to 40,000 board feet, and average from 5,000 to 8,000 feet over extensive areas. The pine forests cover a region 800 miles long and varying in width from 40 to 150 miles on the Sierra Madre Occidental, from the Arizona boundary southward through Chihuahua, Sonora, Durango, Jalisco, and Michoacan. Another belt occurs on the Sierra Madre del Sur, running through Guerrero, Oaxaca, and Chiapas, and across the boundary into Guatemala. There is also a narrow belt of conifer forest on the Sierra Madre Oriental from Nuevo León southward to Pueblo. In the north the lower edge of the forest is composed of chaparral, oaks, junipers, and piñon pines. Then come rather open stands of Chihuahua pine, and higher still, the heavier stands of yellow and white pines, with scattered Douglas fir, white fir, and spruce, especially on north exposures. In the central part of the country cypresses (*Cupressus* spp.) are fairly common, and a bald cypress (*Taxodium mucronatum*) formerly was abundant, but much of it has been cut during the last 400 years. In northern Baja California are two forest tracts, totalling about 250,000 acres, which are an extension of the California forests of yellow pine, sugar pine, incense cedar, lodgepole pine, and big-cone fir. The best pine timber is in a belt between about 8,000 and 10,000 feet in elevation,

above which the firs are more numerous, although some pine reaches 14,500 feet.

Stand of Timber.—The total stand of timber in Mexico has been roughly estimated at 53 billion cubic feet, including all standing material. Another estimate, which is of course only an approximation, is given in Table 297.

TABLE 297.—STAND OF TIMBER, MEXICO

States or Territories	Saw-timber	Other timber estimated in terms of board feet
	Million bd. ft.	*Million bd. ft.*
Chihuahua, Sonora	80,122	66,457
Durango, Sinaloa	38,066	31,574
Tepic (Nayarit), Jalisco, Colima	20,548	17,043
Michoacan, Mexico, Morelos, Federal District	13,962	7,238
Guerrero	14,402	11,945
Tlascala, Puebla, Oaxaca	19,678	12,241
Vera Cruz, Tabasco, Chiapas, Campeche, Yucatan, Quintana Roo	69,016	57,245
All others	18,113	7,512
Total	273,907	211,255

Regardless of the accuracy or inaccuracy of this estimate, it probably gives a fairly good idea of the relative distribution of timber in the different regions. It is reported that about 75 per cent of the stand in the temperate forest belt is composed of the various pines. On the basis of the above estimate, the stand of pine timber probably amounts to 130 billion board feet.

Ownership of Forests.—A large proportion of the forest is still owned by the federal government, although private interests, principally American companies, have secured large tracts of the best timber within the past few decades. In 1909, there was reported to be about 51,476,000 acres of federal land, chiefly in the western part of Mexico and largely though not entirely wooded. There were no lands reported as belonging to individual states, but there were considerable areas of forest owned by municipalities and communities.

Annual Growth.—In the tropical forests annual growth probably just about keeps pace with the annual cut. In the vast areas of virgin pine and oak growth is at a standstill, being balanced by decay and fire losses, while in the regions where lumbering is going on there probably also is no net growth to balance losses from fire, to say nothing of

replacing the timber actually cut. In the woodland and forests near centers of population, where the requirements for fuelwood and charcoal are heavy and carelessness with fires is the rule, the area of forest has been steadily decreasing at the same time that the timber remaining has deteriorated in both quantity and quality. The Mexican Forest Service has estimated that the average annual growth is 1,270,000,000 cubic feet (36 million cubic meters), a year, on the 74,100,000 acres of wooded land, or about 17 cubic feet per acre. This figure, however, should be taken as the potential growth rather than what is actually taking place, since it is probable that loss from decay and from fires, which burn over enormous areas practically every year, more than offsets whatever growth is made.

Annual Cut.—The annual lumber cut of Mexico, which was estimated at about 225,000,000 board feet in 1907, increased rapidly during the next few years, and in 1913 was estimated at nearly 460,000,000 board feet, including hewed ties. The cut of cordwood and charcoal in the latter year was estimated at about 630,000,000 cubic feet, while from 3 to 4 million cubic feet of cabinet and dyewoods were cut for export. Another estimate, made in 1918 but based on prewar consumption, gives for the total cut 706,000,000 cubic feet (20 million cubic meters). Other estimates, which are considerably higher, appear to be unreasonable. The average cut under normal conditions probably amounts to about 700,000,000 cubic feet a year, which is almost 10 cubic feet per acre of forest and woodland.

Exports and Imports.—The southern part of Mexico, especially on the Gulf side from Vera Cruz southeastward, has long been an important source of the world's supply of mahogany, cedar, logwood, and other cabinet and dyewoods. Less has been cut on the Pacific side until the last few years, and only within the last ten or fifteen years has there been any important export of pine lumber from northern Mexico to the United States. Published statistics of the exports of timber and other forest products from Mexico are very unreliable and confusing. As nearly as can be judged, the following were the average annual exports just before the Revolution (5 years ending 1911):

Common woods (cubic feet)	450,000
Fine woods (cubic feet)	3,370,000
Fustic (metric tons)	3,223
Other dyewoods (metric tons)	19,595
Charcoal (metric tons)	25
Firewood (metric tons)	6,298

The total is equivalent to about 5,000,000 cubic feet. The United States took 52 per cent of the volume of common and cabinet woods, 23 per cent went to British Honduras (eventually to Great Britain, for

the most part), 22 per cent direct to Great Britain, and a little more than 2 per cent to other countries. Of the dyewoods (principally logwood and brazilwood) Great Britain took a large share, followed by Russia and Germany, while France took most of the fustic, followed by the United States. The export of dyewoods was much greater before the synthetic dye industry developed. During the 12 years ending 1902 the average annual exports of dyewoods were 51,513 metric tons; of ordinary woods, 200,000 cubic feet; and of cabinet woods, 2,210,000 cubic feet—a total of about 4,300,000 cubic feet. The firewood is mostly oak, cut near the northern border and exported to Arizona.

According to United States statistics, the average annual imports of timber and lumber into the United States from Mexico in the fiscal years 1910-1914 and the calendar years 1919-1920 were as given in Table 298.

TABLE 298.—EXPORTS OF TIMBER TO UNITED STATES

Kind of product	Average 1910–1914	Average 1919–1920
Logwood (long tons)	398	158
Other dyewoods (long tons)	2,144[1]	905
Cabinet wood—unmanufactured:		
Cedar (M board feet)	2,968	1,178
Mahogany (M board feet)	11,205	5,980
Other (M board feet)	– ($12,507)	74 ($5,602)
Logs and round timber (M board feet)	2,663	123
Other unmanufactured (value)	.....	$50,688
Lumber (M board feet)	21,371	22,766
Lath (M)	1,180	533
All other lumber (value)	$4,681[2]	$1,273

[1] 1912 to 1914. [2] 1910 to 1913.

In 1913, Mexico sent over 59,000,000 board feet of sawed lumber to the United States, and this figure probably will be reached again as soon as conditions are stabilized sufficiently for the pine operations of northern Mexico to proceed at full capacity.

The principal exporting ports are Frontera, Carmen, Campeche, Vera Cruz, and Tuxpan, for mahogany and cedar (besides considerable amounts exported by way of Corosal, British Honduras); Mazatlan, Manzanillo, and Salina Cruz for dyewoods and other tropical woods from the west coast; Tampico and some of the others for fustic; and Juarez for pine.

Mexico has been, and still is, one of the United States' best customers for lumber, in spite of her own abundant resources. This is due to the

low prices and ease of obtaining imported pine and fir construction lumber, in comparison with the difficulty of getting out the native pine and its consequent high cost. Imported lumber has been used principally in the coast cities on the Pacific side and on the northern part of the east

TABLE 299.—IMPORTS OF TIMBER FROM UNITED STATES

Kind of product	Average fiscal years 1912–1914	Average calendar years 1919–1920
	M bd. ft.	*M bd. ft.*
Logs and round timber:		
Hardwoods	37	376
Fir		1,225
Pine	15,314	1,545
Other softwoods		5,431
Hewed timbers	575	3,868
Sawed timbers—longleaf pine	4,306	3,261
Other	8,652	11,660
Sawed lumber:		
Longleaf pine	18,651	54,380
Shortleaf pine	21,201	10,221
Other yellow pine	21,113	23,481
White pine	12,785[1]	2,085
Fir	13,016	7,990
Redwood	1,306[1]	2,935
Cypress	157[1]	1,025
Oak	897	1,384
Poplar	265	237
Gum	102	207
Other	2,749	628
Joists and scantling	7,873	.....
Total for products given in bd. ft	128,999	131,939
Railroad ties (number)	552,717[1]	496,862
Shingles (M shingles)	6,395[2]	9,135
Firewood (value)	$18,726[2]	$31,258
Charcoal (value)	$973[2]	.....
Staves (number)	70,247[2]	4,263,078
Heading (value)	$2,015[2]	$70,369
Box shooks (value)	$390,647	$975,577
Other shooks (number)	27,701[2]	50,337
Empty barrels, etc. (value)	$75,890[2]	$109,646
Wood pulp (long tons)	213[2]	1,993
All other lumber (not manufactured products) (value)	$83,805[1]	$300,871
Doors, sash, blinds, trim, etc. (value)	$42,367[2]	$129,295

[1] 1913–1914. [2] 1910–1914.

side, as well as in the interior cities and the mining camps of the north. In the tropical forest region cedar and mahogany and other native species have been plentiful and lower in price than imported pine, and have been largely used for construction and other purposes. The smaller interior towns and camps, and to a certain extent the larger ones, have always used much native timber. In 1907 about 70 per cent of the lumber consumed in Mexico was estimated to be imported, and in 1920 the proportion was about 50 per cent. Practically all of the imported lumber has come from the United States, except for small amounts from Canada. The east coast region uses yellow pine chiefly, while the west coast takes Douglas fir, redwood, and western pine lumber. Average exports of lumber and timber from the United States to Mexico before and since the war are shown in Table 299.

Besides the above products, wooden furniture to the value of about $700,000 a year and large quantities of handles, woodenware, and various other wooden products are imported by Mexico from the United States. In 1919 the total value of wood and wooden products sent to Mexico from the United States was over $6,300,000, being exceeded only by the amounts exported to Great Britain, Canada, Cuba, Argentina, and France, while in 1920 Mexico, with $13,945,000 worth of wood and manufactures, followed Great Britain, Canada, and Cuba. The total volume of wood imported annually was approximately 15,000,000 cubic feet before the war and nearly 16,000,000 cubic feet in 1919-1920.

Domestic Consumption.—The principal consumers of lumber and timbers are the railroads, mining companies, and oil companies, which use large quantities of domestic material in addition to what they import. The use of lumber for dwellings is comparatively unimportant, though large quantities in the aggregate are used for framing, sills, rafters, doors, ceilings, and trim. There were approximately 16,000 miles of railroad in 1914. These use much timber every year for ties, bridges, trestles, and other construction. Considerable quantities are consumed for boxes, barrels, matches, small local manufactures, and at least one mill uses domestic wood for paper pulp. The greatest volume of wood, however, is utilized for fuel, either in the rough state or after being converted into charcoal. As a large part of the population inhabits the higher and cooler plateau region, requirements for fuelwood are considerably greater than in most of the other Latin American countries. The total consumption of wood is approximately as follows:

	Cu. ft.
Lumber and ties—domestic	37,000,000
Lumber and ties—imported	15,000,000
Fuel and minor products	658,000,000
Total	710,000,000

This is 45.8 cubic feet per capita.

The Lumber Industry and Wood-Using Industries.—The lumber and closely related industries are among the most important in Mexico, and employ a large number of people. The cutting of timber and firewood was a fairly well-developed industry for more than 800 years before the Spaniards came. In some parts of the interior the methods employed then are almost the same that are practiced now, and more or less primitive methods of logging, milling, and transportation still prevail over much of the country. Logging on a large scale started first in the low southeastern coastal region, easily reached by water, where the large supplies of valuable dye and cabinet woods attracted first German and French, then British, and finally American timber men. A selective method of logging is used, only the scattered more valuable trees being taken. The logs are skidded by hand or animal power or by steam, to the rivers, where they are gathered in rafts and floated down to where they can be loaded on steamers. Usually they are hewn square in the woods. In Vera Cruz some of the logs are brought out by rail. There are several sawmills in the coastal region, which saw material for domestic use and some for export. Most of the cedar and mahogany readily accessible from the coast and larger streams has been cut. The hardwood stands on the southwest coast are less extensive and harder to get at, and the industry has not been of much importance there. Some dyewoods and a few cabinet woods have been cut for export, and most of the domestic requirements, except for the larger coast towns, have been met from local forests. In this region dyewoods have been packed out for 20 miles or more on mule back.

In the northern and northeastern parts of the country there is little lumbering other than cutting of fuelwood and small timbers for local consumption, except that small amounts of ebony and fustic are cut in Nuevo Leon and Tamaulipas, and exported from Tampico and other ports. The state of Michoacan is an important center of lumber and wood production, and supplies a large part of the requirements of Mexico City and the surrounding territory. Within the last 15 or 20 years, with extension of railroads in the north, foreign capitalists have become interested in developing the pine forests of the Sierras, and several large modern sawmills have been established in Chihuahua and Durango. Although some of these are said to be able to saw from 500,000 to 1,000,000 feet a day, none has operated at full capacity. In this region equipment and methods are similar to those used in the western United States. Much lumber is shipped rough to El Paso (U. S.), where it is finished.

Industries manufacturing wooden products are not of great importance in Mexico. Some furniture is made in small local shops, principally

by hand, and there are a few larger factories, as at San Luis Potosi, but a large part of the requirements for furniture, which are rather limited, is met by imports. The box and cooperage industries are of some importance in certain sections of the country, and matches are made in several factories, principally in Puebla and Mexico City. Much wood is employed in building carts and other vehicles, most of which are also hand made. There are several paper mills at Vera Cruz and Mexico City, and at least one at the latter place uses native wood for pulp.

Forestry Movement and Legislation.—The Mexican people as a whole have not taken any interest in the conservation or perpetuation of their forest resources, and vast areas of valuable forest land have been granted to private interests for little or no compensation. Devastation of both public and private forest lands has proceeded unchecked for more than twelve centuries, and the only thing that saved any of the forests was their inaccessibility. Denudation finally reached the point, in the region surrounding the populous Valley of Mexico, where its serious results became plain enough to arouse sentiment in favor of restricting further cutting and protecting the trees that remained. In 1901 a Forestry Commission was created to investigate and make recommendations for dealing with the situation, and in 1904 the Junta Central de Bosques was established in the Department of Agriculture and Promotion, developing in 1909 into a Forest Service. A number of forest guards were provided to protect the federal forests against fire and depredations, and the forests of the Federal District were put under strict control and technical management. A central organization was created to carry on investigations and propaganda, administer the public forests, and maintain nurseries for raising planting stock. Large nurseries have been established in the Federal District and at Vera Cruz, and a school for training forest guards (Escuela Forestal Práctica) was opened at Santa Fe (Federal District) in 1910. In 1917 a national forest school for training technical foresters was opened at Coayacan, also in the Federal District. The appropriations for the Forest Service in 1912 amounted to $331,368 (about $165,000 U. S.), and receipts were $477,575 ($238,000 U. S.), of which $261,285 was from export duties and $216,290 from exploitation of the national forests.

A new law for forest preservation was submitted to Congress in 1921 and was expected to pass without amendment. According to its provisions, the lands covered with forest vegetation (including chaparral or brush as well as timber) are to be classified as within "protected" zones or "unprotected" zones. Protected zones include public lands on the banks of streams, lakes, or seacoasts, those of recreational or scenic value, national parks, experimental forests, and both public and private lands of the following classes: those in upper valleys or canyons

where floods are liable to damage the lands below; those on banks of streams or lakes crossing two or more properties; dunes; lands whose protection is necessary to conserve water supplies; forests of military or strategic value; all forest lands in the Valley of Mexico. All forest lands belonging to the nation, to municipalities, or to communities are subject to forestry regulations of the Department of Agriculture, as are also all private forest lands in protected zones. Within these zones the area of forest land may not be reduced for any reason whatever, and exploitation must be conducted according to the regulations of the Department. Other sections of the law deal with forest reserves (federal lands of no value for agriculture), lands in common ownership, and other matters. One section provides for the reforestation of government land, and that private owners under certain conditions may be compelled to reforest their lands, under penalty of confiscation by the federal government.

Secondary Forest Products.—*Dyewoods.*—The dyewood industry of tropical Mexico was developed first by the Germans and French, and later it was almost monopolized by the British. Recently, however, the United States has taken a considerable portion of the exports. The most important dyewoods are logwood, or campeche (*Haematoxylon campechianum*) chiefly from Yucatan, Campeche, Tabasco, and Vera Cruz; brazilwood (*Caesalpinia crista*), from most of the tropical belt; and fustic or palo moral (*Chlorophora,* or *Maclura, tinctoria*), mostly from the drier regions of the northern east coast and the southern Pacific coast. Other less important sources of dye are palo amarillo, sangre de drago (*Pterocarpus draco*), palo mulato (*Bursera gummifera*), and torote (*Bursera microphylla*). Exports of dyewoods averaged 51,513 metric tons a year during the period 1891–1902, but steadily declined in the face of the competition of synthetic dyes, and from 1906 to 1910 averaged only 22,817 tons a year.

Tanning Materials.—Mexico has abundant supplies of tanning materials, and considerable quantities are consumed within the country. Exports are insignificant, consisting almost entirely of cascalote or divi-divi (the pods of *Caesalpinia coriaria* and *C. cacolaco*). The average annual export of this material during the period 1906–10 was 535 metric tons. It is also the principal tanning material used in Mexico. The center of distribution is at Toluca. The city of Leon is said to have 26 tanneries, which together consume 6 metric tons a day of cascalote. Oak bark is extensively used, principally from *Quercus xalapensis, Q. castanea,* and *Q. imbricaria.* Palo blanco (*Lysiloma candida*), several species of *Mimosa,* and timbre or timbe (*Acacia malacophylla*) are employed to some extent, while huamuchil (*Pithecolobium dulce*) is much used in Jalisco and Morelos for tanning saddle and harness leather.

Raicilla (*Calliandra grandiflora*) is used in Morelos for making a soft leather. Torote (*Bursera microphylla*) is utilized in Baja California and other states, and both pods and bark of huincastle (*Enterolobium cyclocarpum*) are employed for tanning. The leaves of several species of sumac (*Rhus*) are rich in tannin. Mangroves, which are abundant along parts of the coast, have been used chiefly for fuel and very little for tanning.

Rubber.—Two kinds of rubber trees, hule (*Ficus* sp.) and caucho (*Castilloa elastica*), which grow wild over most of the tropical forest zone, yield a product of some importance Until recently little rubber had been planted. The average yearly production from 1898 to 1902 was reported to be about 240 metric tons. No figures regarding more recent production are available except that there was exported to the United States an average of 1,439,000 pounds a year from 1911 to 1914, and 932,000 pounds from 1919 to 1920. The total average exports of rubber between 1906 and 1910 are given in Mexican statistics as 5,170 metric tons, but this probably includes guayule rubber, which is not a forest product. According to United States statistics, 10,656 metric tons of rubber, valued at $10,918,000, was imported from Mexico in 1910.

Gums.—One of the most important articles exported from Mexico is chicle, used in the manufacture of chewing gum. It is produced by the chicozapote (*Achras sapota*). The average quantity exported from 1898 to 1902 was over 1,200 metric tons, valued at over $800,000, all to the United States; and from 1906 to 1910 the annual amount was 2,488 tons, valued at about $1,200,000 (U. S. money). During the period 1910–14, 2,532,000 pounds of chicle a year, valued at $790,000, was sent to the United States, while in 1919–20, the average quantity was 4,580,000 pounds, valued at $3,360,000. Chicle comes from the tropical forest, especially from the Yucatan peninsula. Other gums include copal (from *Bursera* sp.), of which 90 tons a year was exported between 1898 and 1902; mesquite gum (from *Prosopis juliflora*) of which the annual exports were 70 tons druing the same period, and tacama (from *Bursera* sp.).

Naval Stores.—With her extensive stands of pine timber, Mexico has the basis for an important naval stores industry. Not only are there several yellow pines, such as *P. teocote, P. arizonica* and *P. ponderosa,* which are said to be rich in resin, but several of the other pines yield resin freely. The best forests for turpentining are in the States of Michoacan, Guerrero, Oaxaca, and Durango. For many years some turpentining was done on a very small scale and by crude methods. In 1907, a modern plant, with a capacity of 4,200,000 gallons of raw turpentine a year, was established near Morelia, Michoacan. During the years 1910 to 1914 Mexico exported to the United States an average quantity of 45,000 gallons of spirits of turpentine a year, and imported 6,900

gallons a year, together with 1,134 barrels of rosin and 1,300 barrels of tar, turpentine, and pitch.

Other products include oils from coconut, coquito de aceite, corozo, and other palms, which are especially abundant in Colima, Chiapas, and Tabasco; vegetable ivory from the corozo or tagua palm, of which 116,000 pounds a year was exported to the United States during 1910–14; essence of linaloe from *Bursera aloexylon,* of which 23 metric tons a year was exported during 1906–10; and pulpwood, including fir (*Abies religiosa*) and some of the pines, as well as some of the softwoods of the tropical forest. In 1914, 55,000 pounds of mechanical pulp were exported to the United States, but larger quantities went in the opposite direction (477,000 pounds a year from 1910 to 1914, and 1,993 long tons from 1919 to 1920). Mexico also imported from the United States newsprint paper amounting to 1,245,000 pounds a year (1910–14), and 1,800,000 pounds a year during 1919 and 1920.

The Probable Future.—With the extension of transportation routes that is bound to come in a very few years, there is no reason why Mexico should not become self-supporting as far as wood is concerned. Indeed, it is likely that she will greatly increase her exports of pine lumber, and will take less and less pine and fir from the United States. At the same time that the railroads are extended and new industries grow up along their lines, the domestic requirements for timber will increase, and unless decisive action is taken to keep the forests in a productive state, before cutting proceeds too far, there will be danger of early exhaustion of the best timber, just as is happening in the United States. The mountain forests, which have been able to withstand the primitive hand-lumbering methods and ox or mule transportation over poor roads or pack trails, will melt away quickly before the attack of modern steam-power logging and milling equipment, backed by rail connections to the consuming centers of Mexico and the United States. Most of the present forested area, except perhaps some of that in the tropical belt, is non-agricultural land that should always produce forest crops, and a large area not now covered with timber falls within the same category. It is probable, therefore, that the total forest area of Mexico may eventually be considerably larger than it is now.

Mexican Trees.—The following are a few of the more important species of trees, out of the hundreds native to the country.

TABLE 300.—IMPORTANT TREES, MEXICO

Aguacate (*Persea americana*) besides being valuable for its fruit (avocado) furnishes excellent hard cabinet wood.

Ahuehuete or sabino (*Taxodium mucronatum*) is one of the largest trees in the world, the famous tree of Santa Maria del Tule being 35 feet in diameter and 150 feet high. Originally there were extensive stands of the species in the Valley of Mexico,

TABLE 300.—IMPORTANT TREES, MEXICO—*Continued*

as well as in other regions from Coahuila to Guatemala, but now the best have been cut. The wood, which resembles that of the bald cypress (*T. distichum*) of southern United States, is highly valued for construction and furniture.

Amapa (*Tabebuia* sp.) is an abundant tree, whose wood is employed extensively in shipbuilding. It weighs from 50 to 54 pounds per cubic foot. There are several varieties.

Arrayan (*Myrtus arayan*) has hard wood, weighing from 57 to 63 pounds per cubic foot, and much used for ties and construction on the west coast.

Arellano or palo colorado is said to be one of the softer hardwoods, but its wood is strong, durable, and extensively used for construction.

Balsa or corkwood (*Ochroma* sp.) occurs in scattered tracts on the south coast, and some is cut for export.

Balsamo (*Myroxylon* sp. or *Toluifera pereirae*) has light brown wood used for furniture and trim, and yields "Peru" balsam.

Baritillo or palo margarita has very hard wood, utilized in shipbuilding.

Campeche (*Haematoxylon campechianum*) yields excellent cabinet and construction material, but is of greater value as a dyewood (logwood). While it occurs through most of the tropical zones, it is best on the Yucatan peninsula. *Haematoxylon braziletto*, which is sold with it as logwood, extends as far north as Chihuahua.

Caoba or mahogany (*Swietenia mahagoni*) is the best known tree of tropical Mexico. A large part of the remaining supply of American mahogany is in southern Mexico. Besides the great quantities that are exported, it is used locally for cabinet work, general construction, and railroad ties.

Caobilla (*Croton lucidum*) resembles mahogany, but the wood is softer and less durable.

Cedro or palo amargo (*Cedrela odorata*) is fairly abundant in virgin forests, and although the biggest trees have been cut from accessible stands, it is said to reproduce well and grow very rapidly, and is about holding its own.

Cedro is also the name for various species of *Juniperus*, some of which are small trees, others large. *J. pachyphloea* reaches diameters of from 3 to 5 feet and heights of 50 to 60 feet, and is a very valuable tree in northern Mexico, at elevations between 4,000 and 6,000 feet. *J. mexicana*, called sabino and enebro, is almost as large and taller, and is widely distributed over all except northwestern Mexico, extending into Guatemala. It is used for construction, posts, poles, ties, and fuel. Some species of juniper occur in nearly all parts of Mexico above the tropical zone.

Chijol or habi (*Ichthyomethia communis*) has very durable, close-grained, yellowish-brown wood, which takes a fine polish, weighs about 55 pounds per cubic foot, is not very strong, and is used for boats and cabinet work.

Cipres or cedro includes several species of *Cupressus* (*C. arizonica*, of northern Mexico; *C. benthami*, of central and southern Mexico and Guatemala; *C. thurifera*, of central and southern Mexico; *C. guadelupensis* of Guadeloupe Island and Baja California). All of these yield soft, fine-grained timber of excellent quality.

Conocaste, guanacaste, huinacaztle, or orejon (*Enterolobium cyclocarpum*) has yellowish gray to dark brown wood, strong, coarse-grained, fairly light (35 pounds per cubic foot), easy to work and finish, and durable in soil or water. It is much used for canoes, carpentry, cabinet work, and general construction. The tree grows fast and reaches large size.

Ebano (*Calliandra* sp.) has hard, heavy, dark colored wood, utilized for ties and cabinet work. It weighs 77 pounds per cubic foot. Another ebano (*Pithecolobium flexicaule*) has dark red or purplish-brown wood, weighing about 65 pounds per cubic foot. It is exported as a cabinet wood, from Nuevo León and Tamaulipas.

TABLE 300.—IMPORTANT TREES, MEXICO—*Continued*

Encinas, the evergreen oaks, and robles, the deciduous species, are the most widely used hardwoods in Mexico. There are more than 100 different species of small and large oaks, about evenly divided between the white oak group and the black or red oak group. They occur in the tropical zone as well as in the cold belt, but are most numerous just below the conifer zone. The various species furnish large quantities of timber for construction, shipbuilding, furniture, interior finish, vehicles, ties, and fuel, and the barks of several species yield tannin.

Gateado (*Swietenia humilis*) is a heavy, inferior, light-colored mahogany, used for construction and cabinet work.

Granadilla (*Brya ebenus*) also called cocuswood and brown or green ebony, has deep green or brownish wood, hard, strong, heavy, tough, durable, and resinous, so that it takes a high polish. It is used for cabinet work. Another granadilla (*Dalbergia* sp.) is similar to the cocobola of Panama. *Pithecolobium multiflorum* is also called granadilla.

Guapaque (*Ostrya guatemalensis*) has very hard, heavy, compact, strong wood of reddish color, excellent for furniture and ties. Its bark yields tannin and dye.

Guapinol, cuapinole, or algarrobo (*Hymenaea courbaril*) is a hardwood which is valuable for construction and cabinet work. It is brown or dark red in color, and takes a high polish.

Guayacan (*Guaiacum officinale* or *G. verticale*) is a lignum vitae, used for turned ware, heavy construction, and cabinet work. Palo santo (*G. sanctum*) is smaller, but similar.

Haya (*Caesalpinia mexicana*) yields a valuable cabinet wood.

Huamuchil (*Pithecolobium dulce*) is widely employed for general construction, fuel, and posts. Its bark yields tannin and dye.

Huisache includes several species of *Acacia*, *Cassia*, *Mimosa*, *Piptadenia*, and *Pithecolobium*, which are abundant in the dry foothill forests of central and northern Mexico, and are of considerable local importance for construction, mine timbers, and fuel. The wood of some species resembles hickory and makes excellent spokes and rims.

Linaloe (*Bursera aloexylon*) furnishes excellent cabinet wood, and also yields an essence which is exported for use in making perfumes.

Macayo, macaserbo, pacay, or maco colorado (*Andira excelsa*) has strong, hard wood, with some of the qualities of hickory. It is used by the natives in wagon making.

Madre de cacao or madera negra (*Gliricidia sepium* or *G. maculatum*) is abundant on the Pacific side, where it is used for house frames, ties, posts, and cabinet work. The wood is hard, heavy, dark reddish-brown in color, and is said to last in the ground for more than 100 years without decaying.

Maria, palo maria, or santa maria (*Calophyllum calaba*) is a large straight tree, with wood resembling mahogany, except that it is coarse grained. It is strong and durable under water, and is utilized for construction, shipbuilding, furniture, wheels, finish, and shingles.

Mauto, meuto, or tepemezquite (*Mimosa* sp.) has hard, strong wood, weighing nearly 60 pounds per cubic foot, employed for ties and shipbuilding.

Mesquite (*Prosopis* spp.). Mesquite wood weighs from 56 to 62 pounds per cubic foot, and is valuable for cabinet work and for special purposes, besides its great value for local construction timbers, ties, fencing, and fuel.

Mora, moradillo, palo moral, or fustic (*Chlorophora tinctoria*) has wood which is very hard, strong, and durable in the soil. It weighs from 50 to 58 pounds per cubic foot. It is valued for furniture, finish, and wheels, and especially for yellow, brown and green dyes, large quantities being exported for that purpose.

TABLE 300.—IMPORTANT TREES, MEXICO—*Continued*

Nazareno, ojite, or ramon (*Brosimum alicastrum*) has hard, white wood used in cabinet work.

Nogal includes four or more species of *Juglans*, occurring mostly in central and northern Mexico. The wood, resembling American black walnut, is used for cabinet work.

Nogalillo and nogal morado include several hickories (*Hicoria mexicana*, *H. pecan*, *H. myristicaeformis*) which occur in northeastern and central Mexico, reaching fairly large size.

Oyamel, abeto (*Abies religiosa*) is one of the best Mexican conifers, occurring at elevations from 4,000 to 11,000 feet, from San Luis Potosi and Jalisco to southern Guatemala. It frequently forms dense pure stands, with trees 150 feet tall, and in Guatemala sometimes reaches a diameter of 6 feet and a height of 200 feet. It makes especially good shingles, lath, and paper pulp, and furnishes considerable construction lumber.

Palo blanco (*Celtis mississippiensis*) is fairly common and reaches large size in northeastern Mexico, where it is used for lumber and for making vehicles. The soft yellow wood weighs only about 30 pounds per cubic foot. Another palo blanco (*Lysiloma candida*) is of considerable importance as a source of tanbark.

Pino includes some 20 or 25 species of pines, with a combined stand probably as great as that of all the rest of the timber in Mexico. The most important for their timber are: *Pinus arizonca*, *P. chihuahuana*, *P. leiophylla*, *P. ponderosa*, and *P. teocote*, yellow pines; and *P. ayacahuite*, *P. altamirani* (or *P. lawsoni*), *P. hartwegii*, *P. montezumae*, *P. oocarpa*, and *P. pseudostrobus*, white pines. *Pinus ponderosa* is the same species as the common yellow pine of the western United States. It extends for some distance south of the boundary in Chihuahua, Durango, Sonora, and Baja California.

Pinus arizonica is a closely related species, common in Chihuahua and parts of Nuevo León, where it is the principal timber pine. It reaches diameters of 4 feet and heights of 100 feet, and is very resinous.

Pinus chihuahuana is a small or medium sized tree with soft wood, common at the lower edge of the timber belt in northern Mexico, and of great economic importance in that region, because it is the most accessible to the consuming population.

Pinus leiophylla, called ocote chino, is one of the most valuable pines of Mexico and Guatemala. It is a large tree, and its wood is hard.

Pinus teocote, called ocote, jalocote, or candlewood pine, ranges from Nuevo León to Central America, at elevations between 6,000 and 9,000 feet. It is a tall tree, rich in resin, and makes excellent lumber and ties.

Pinus ayacahuite, called ocote blanco, is a large tree, and is the most common and one of the best white pines of Mexico and Central America.

Pinus hartwegii is one of the most valuable pines. It is a medium-sized tree, occasionally 140 feet tall, and has soft reddish wood.

Pinus montezumae, called pino blanco, ranges from northern Durango to Guatemala, and is the commonest and most generally used pine between 17° and 25° north, at all elevations between 4,000 and 12,000 feet. The stand of this pine in southern Mexico is said to be greater than that of all the other pines together. Its wood is white, soft, and resinous, and equal in quality to that of *P. strobus* of the United States.

Pinus oocarpa is a medium sized pine of the subtropical zone, from Guatemala to Zacatecas. It resembles *P. hartwegii*.

Pinus pseudostrobus, called pino real, reaches diameters of 6 feet, and ranges from Nicaragua to Durango and Sinaloa.

TABLE 300.—IMPORTANT TREES, MEXICO—*Continued*

Pinus altamirani or *P. lawsoni* is a common pine of fair size.

Piñon pines, of several species, are of great economic importance in the semi-arid regions of northern Mexico, where they furnish large quantities of fuel and some construction material.

Pino corcho or pinabete (*Pseudotsuga taxifolia* or *P. mucronata*), the Douglas fir of the United States, extends as far south as the State of Chiapas, in the higher mountains.

Pochote or ceiba (*Eriodendron* sp.) is a large fast-growing tree of the tropical zone, with soft wood used for cheap lumber.

Prima vera or white mahogany (*Tabebuia donnellsmithii*) has moderately hard, light-yellow wood, which is strong and durable, and is much used for furniture and interior finish. The best of it is in the southwest coast region. Some is exported. Another species, *T. rosea*, is called palo de rosa, and is also a cabinet wood.

Tapinceran (*Mimosa* sp.) is a tree of the southwest coastal region, which furnishes cabinet wood.

Zapote mamey (*Lucuma* sp.) has wood which resembles walnut, polishes well, and is valued for furniture and finish.

Zapote chico or chicozapote (*Achras sapota*) is a large tree, abundant in some localities, and has deep reddish-brown, hard, strong wood, which is fairly easy to work while green, splits with difficulty, finishes well, and is very durable. It lasts well in water and is said to be proof against teredo attacks. It is much used for high grade furniture and finish, as well as for house framing, but is of even greater value as the source of chicle.

Zapotillo colorado and zapotillo blanco are excellent woods for furniture and interior trim, and are fairly common.

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WEST INDIES

BRITISH WEST INDIES

The British West Indies include a large number of widely scattered islands, governed as several distinct colonies. They are:

1. Bahamas.
2. Barbados.
3. Bermuda (does not strictly belong to the West Indies group).
4. Jamaica and the Caymans.

5. Leeward Islands.
6. Trinidad and Tobago.
7. Windward Islands.

Bahamas

The Bahama Islands number more than three thousand, scattered in a broad belt 700 miles long between the eastern end of Cuba and the coast of Florida. There are only 18 principal islands or groups, and only about 30 are inhabited, the rest being small, low, coral keys, most of which, however, bear more or less small tree growth. The total area of the islands is about 4,400 square miles, and the total population about 57,000.

Abaco, Andros, Grand Bahama and New Providence islands have extensive forests of yellow pine (*Pinus bahamensis*) covering about 433 square miles out of the total area of 2,864 square miles. These forests are distributed as follows:

Abaco—102,400 acres, including 25,600 acres of restocking cutover lands.

Andros—99,840 acres.

Grand Bahama—70,400 acres.

New Providence—4,480 acres.

The Caicos Islands also have some pine forest.

The pine is of fairly good quality but is not very large, running from 8 to 15 inches in diameter, with about 30 feet of clear bole. Although it contains considerable resin, it has not been turpentined except as an experiment.

Great Inagua, with an area of 560 square miles, has large areas of tropical hardwoods, including lignum vitae, logwood, satinwood, braziletto, and many others. There are "hammocks" of tropical hardwoods, including mahogany, in the pine forests, as well as small areas of hardwoods on many of the small islands. A fairly common tree is cedar (*Juniperus bahamensis* or *J. lucayana*).

The total forest area of the Bahamas is probably about 575 square miles (368,000 acres), which is nearly 13 per cent of the land area and about 6.5 acres per inhabitant. The pine forests have been but little reduced in area, while much of the land once covered with hardwoods has been cleared for agricultural use, and most of the timber on the smaller islands has been cut for fuel and building. Practically all of the pine forests and much of the hardwoods still belong to the crown, which allows cutting under license.

Besides small amounts of lumber cut locally, there is one large sawmill on Abaco Island, which cuts about 70,000 board feet of pine a day. In 1913, it cut 12 million board feet, and during the period of 1907-1913, produced 6,132,303 cubic feet of lumber and 1,800,000 shingles. This

mill suspended operations in 1913, but resumed again in 1919. The total annual cut of the colony, including lumber, fuelwood, and other material, is estimated at approximately 1,600,000 cubic feet. During the period 1907-1919 exports of pine lumber averaged 302,000 cubic feet a year, most of it going to Cuba. About 10,000 feet a year of lignum vitae, and small quantities of logwood, sabicu, and braziletto are exported, making the total average exports about 315,000 cubic feet. Imports, chiefly of softwood construction lumber, cypress shingles, and shooks, from the United States, averaged nearly 90,000 cubic feet a year during the period 1907-1919. The total domestic consumption, a very large proportion of which is used in or near Nassau, the capital, is approximately 1,375,000 cubic feet a year, or 24 cubic feet per capita.

No particular interest is taken in forest conservation, and surface fires are of common occurrence in the pine woods, where they seriously hinder reproduction and impoverish the soil but do not greatly harm the merchantable timber. There are certain laws relating to trespass on crown lands, and also one forbidding the wilful starting of wood fires. In spite of the lack of attention, considerable young growth is starting, and it is estimated that the pine timber will last at least 70 years at the present rate of cutting.

Barbados

Barbados, the easternmost island of the West Indies, has an area of 105,560 acres, of which more than 90,000 acres is cultivated. The population is about 200,000, or more than 1,200 to the square mile, which makes it one of the most densely populated districts in the world. Practically all the forests were cut many years ago, and now there remains only 66 acres of woodland (0.06 per cent of the total area), besides the scattered shade trees along roadsides and around dwellings. In 1907 the "Preservation of Trees Act" was passed, to encourage planting by offering bounties to persons who would plant and successfully grow one or more acres of commercially valuable trees. Little has been accomplished under the Act.

The consumption of wood is fairly large, not only for building but also for box shooks, staves, posts, and even firewood and charcoal. All have to be imported. The United States supplies practically all of the staves and shooks, and yellow pine construction lumber; Canada supplies white pine and spruce lumber; and British Guiana and some of the neighboring islands are the sources of fenceposts, shingles, narrow-gauge railroad ties, fuelwood, and charcoal. Values of wood imports in 1914 and 1915 are given in Table 301.

While the quantities of the different products were not given, it may be roughly estimated that these values represent about 2,400,000 and

2,200,000 cubic feet, respectively, equivalent to an average consumption of about 11.5 cubic feet per capita.

TABLE 301.—IMPORTS OF WOOD, BARBADOS

Kind of material	1914	1915
Charcoal	$45,565	$46,268
Construction wood (spruce and white pine)	103,306	158,619
Pitch pine lumber	44,704	34,068
Hardwood	12,448	13,794
Shingles	59,902	11,665
Staves and shooks	153,839	107,459
Hoops	19,709	13,932
Fuelwood	69,717	53,210
Total	509,190	439,015

Bermuda Islands

The Bermuda Islands number about 360, of which only about 20 are inhabited. The dry land area is 12,373 acres, and the population about 21,000, or nearly 1,100 to the square mile. The entire group was originally almost all covered with woodland, and some of the smaller islands are still well-wooded. Moreover, there still remain considerable areas of cedar on the larger islands, possibly 1,500 acres in all.

For more than 100 years after 1616, cedar (*Juniperus bermudiana*) was the principal article of export from the islands. It was highly prized in England as a cabinet wood before mahogany was introduced, and brought high prices. There are records of cedar planks 12 to 13 feet long, and from 30 to 32 inches wide, although no such trees exist now. Cutting proceeded so rapidly that before 1622 there were legal restrictions regarding the reckless cutting of cedar and palmetto. It was forbidden to export cedar except in the form of tobacco chests, but this law was circumvented by making the chests very large, of thick boards. Cedar was also used on the islands for boat building, dwellings, and fuel. Much was burned in 1616-1618, to destroy the wood rats, which had become a serious pest. The species restocks fairly well naturally, and grows rapidly, some trees reaching 10 or 12 inches in diameter in 40 years. The area of cedar forest is believed to have increased during the last 50 years, and many stands are so dense that they need thinning. Although there are no longer any restrictions on cutting, practically all owners realize the value of their woodlands and handle them well.

Other trees include yellow wood (*Xanthoxylum aromaticum*), which

yielded valuable cabinet wood, exported for several years, but was practically extinct by 1650; olive wood (*Elaeodendron xylocarpum*), a small tree, now rare, the bark of which was once used for tanning; mangrove (*Rhizophora mangle*); buttonwood (*Concarpus erectus*), and black mangrove (*Avicennia nitida*), still fairly common on tidal flats; palmetto (*Sabal blackburniana*), which reaches heights of 50 feet; and fiddlewood (*Citharexylum quadrangulare*), a common tree of rapid growth but of little economic value.

Except for about 4,600 cubic feet of cedar cut locally, the wood requirements of the islands are met by imports from Canada and the United States. The agricultural industry, which is very important, requires large quantities of box and crate material and barrels, which make up the greater proportion of all wood consumed. During 1916 and 1917, imports of lumber, shooks, and barrels averaged about $80,000 in value, while in 1919 they were valued at nearly $120,000, classified as follows:

	From U. S.	*From Canada.*
Lumber (cubic feet)	34,152	12,257
Box shooks (packages)	97,773	73,828
Lath (packages)	500	2,593
Empty barrels and staves (number)	32,713	4,044
Spars (number)	17	27

The total volume of wood was probably close to 200,000 cubic feet, and the total consumption, therefore, about 10 cubic feet per capita.

Jamaica

The colony of Jamaica includes the island of Jamaica, with an area of 4,207 square miles; the Cayman Islands, about 150 miles to the northwest; the Turks and Caicos Islands, which are at the southern end of the Bahamas group, and a number of small keys. The total area is about 4,430 square miles, and the population about 900,000.

Extent of Forests.—The forests of Jamaica proper cover about 800,000 acres, including scrubby forests valuable chiefly for fuelwood, or about 400,000 acres of real productive forest. This is about 15 per cent of the land area, and less than 0.5 acre per inhabitant. The Cayman islands are well wooded, and have probably 50,000 acres of forest altogether.

Character and Distribution of Forests.—The greater part of the island was originally covered with forest, but all except the least accessible localities or those unsuited to agricultural use have been cleared. The topography is very rough, with average elevations between 1,000 and 2,000 feet, and a maximum (Blue Mountain) of 7,360 feet. Less than one-sixth of the island is anywhere near level, but many of the

slopes up to 5,000 feet elevation are planted to coffee, ginger, and other crops. About 30,000 acres of forest is cleared each year for growing ginger, but this land, after two or three years' cultivation, reverts to more or less inferior second-growth woodland, or "ruinate." The only real timber forests, covering about 100,000 acres, are back in the higher mountains, where ginger does not grow. These forests are of even more value for protection of watersheds than for their timber, and are mostly crown lands, while the second growth is nearly all in private ownership.

The forests are composed of a very large number of tropical species, of which more than 100 are of economic value. The woodland is much broken up, however, and the stands rather light, except in the limited area of virgin forest on the higher mountains. On some of the mountains there are several sub-tropical coniferous species, including cedar (*Juniperus barbadensis,* or *J. bermudiana*), and yaccas (*Podocarpus* spp.). The Colonial Department of Agriculture lists 113 woods, of which 46 are suitable for cabinet work, 35 for house finish and furniture, 35 for general inside work, 40 for general outside work, 20 for turnery, 17 for vehicle construction, 17 for posts, 15 for shingles, 12 for piles, 9 for railroad ties, 8 for cooperage, and 6 additional for fuel. Among the more valuable are Spanish cedar, mahogany, mahoe, satinwood, Blue Mountain yacca, rosewood, yellow sanders, zebra wood, braziletto, bullet wood, bastard cedar, and lignum vitae. Logwood is perhaps the most important tree, economically, on the island, and fustic is also important.

Annual Cut, Exports and Imports, and Domestic Consumption.—Most of the lumber used in Jamaica is imported, chiefly from the United States. There is one sawmill cutting about 10,000 board feet a day of local woods, and another smaller one, but most of the native lumber is sawed by hand. The total cut for lumber, ties, posts, and similar uses probably does not exceed 500,000 cubic feet a year. By far the greatest consumption of wood is for firewood and charcoal—at least 9,000,000 cubic feet of timber a year. The cut of logwood and fustic for export, either as logs or as extract, amounted to about 2,000,000 cubic feet a year just before the World War, and considerably more than that during the war. Wood cut for all other purposes probably does not exceed 500,000 cubic feet yearly. The total cut, therefore, may be estimated at 12,000,000 cubic feet. The annual growth is probably somewhat less than this amount, or about 8,500,000 cubic feet.

Except for very small quantities of mahogany, cedar, satinwood, lancewood, ebony, and a few other comparatively rare cabinet woods, the timber exports of Jamaica consist of dyewoods. Logwood has been exported to Europe for several hundred years, most of it going to Great Britain, but more recently the United States has taken nearly all of it. Aniline dyes have largely taken its place in dyeing woolens, but it is

still in demand for coloring leather and some textiles. Exports of this wood have ranged from 22,000 to 115,000 tons, and for the ten years preceding 1914 averaged about 35,000 tons. In 1916 more than 74,000 tons was exported. Within the last twenty or thirty years there has been a tendency to make logwood extract in Jamaica instead of shipping the wood, and large quantities of extract are now exported, mostly to Great Britain. During the four years ending with 1914, the average annual value of the combined exports of logwood and extract was over $1,250,000. Of fustic, the average export before the war was about 3,000 tons, valued at nearly $40,000.

Imports of lumber from the United States during the four years ended June 30, 1914, averaged 13,850,000 board feet, and in the last year of the period were nearly 23,000,000 board feet. Most of it was yellow pine. In addition, there were imported from the United States 1,880,000 shingles, 217,000 box shooks, 50,000 other shooks, and 110,000 staves. Small amounts of shooks and other products were imported from other British possessions. The total annual import amounts to about 1,500,000 cubic feet, and the domestic consumption is approximately 11,500,000 cubic feet, or nearly 13 cubic feet per capita.

Forest Conservation and the Future Outlook.—Jamaica has no forestry department, and little has been done toward developing a forest policy. Fortunately, old cut-over lands restock fairly quickly after cultivation is abandoned, and the growth of many species is very rapid—logwood, for instance, reaches merchantable size in 10 years, so considerable timber is still left on the island. It is hardly probable that a much larger share of the total consumption will ever be supplied by native timber, because even though domestic production can be greatly increased by proper management, the requirements of the local population and industries will probably increase even more rapidly.

Leeward Islands

The British Leeward Islands include the following:

St. Kitts, or *St. Christopher,* 65 square miles in area, with 30,000 population, is a volcanic island with rough topography, culminating in a peak 4,319 feet above sea-level. The higher country is wooded, comprising about 9,500 acres, or 23 per cent of the island. This woodland, all of which is in private ownership, is very valuable for watershed protection because of the agricultural lands below it. The Forestry Ordinance of 1903 created a Forestry Board to administer regulations against deforestation and to promote reforestation. No owner may clear forested land for any purpose without the consent of the Board, nor may he cut timber without a permit except for specified domestic uses, and where permits are granted the manner of cutting is subject to regulation. The Board

may order an owner to reforest certain areas, granting such financial assistance as seems proper, or may do the work itself. Making of charcoal may be done only under permit, nor may timber or charcoal be exported except by special permission. The principal use for domestic woods is for charcoal, which is the common fuel. Many of the houses are of frame construction, made of lumber from the United States and Canada, and small amounts from other countries. Total imports in 1907 were 807,000 board feet of lumber, and 1,912,000 shingles, or about 85,000 cubic feet, for the group of islands including St. Kitts, Nevis, and Anguilla.

Nevis, about 50 square miles in area, with 13,000 people, is also a mountainous volcanic island. It has 3,520 acres of forest, or 11 per cent, on the higher mountains. Practically all is privately owned, and subject to the same regulations as the forests of St. Kitts.

Anguilla, 35 square miles in area, with 5,000 inhabitants, is a rather low coral island with no timber except scattered shade trees.

Virgin Islands, including Anegada, Tortola, Virgin Gorda, and several others, have a combined area of 58 square miles and a population of 5,600. Anegada is a low coral island with almost no tree growth, but the other two are mountainous, and have some scattered timber in sheltered ravines, and mangroves along the coast. There is a small area of virgin timber in the highest part of Tortola. No forestry regulations are in force.

Antigua is 108 square miles in area, and has 35,000 inhabitants. The island has been practically denuded of forest by cutting for fuel, followed by frequent grass fires, which prevent reproduction. There are some small timber areas in the southwestern part, including mangrove swamps along the coast. Some planting is being done by private owners, to supply fuel, posts, and narrow-gauge ties. There are no forestry regulations, except an ordinance concerning the setting of grass fires and providing for extinguishing them. The associated islands, Barbuda (75 square miles) and Redondà, are flat, have no timber, and are only thinly populated.

Montserrat has an area of 33 square miles, and 15,000 inhabitants. It is rugged and mountainous, and the higher parts are wooded. A hurricane in 1899 destroyed most of the forest but it has restocked since. The forests, which cover 5,000 acres, or 24 per cent of the island, are all privately owned. The Forestry Ordinance of 1903 provided for a Forestry Board, which may proclaim any timbered area a forest reserve, and subject it to such regulations as the Board may make for the purpose of keeping it a forest. The Board has authority to make regulations controlling the management, cutting, and removal of timber, burning of charcoal, or cultivation of land within the reserves, which are exempted

from the land tax. The Board may also regulate the setting of fires in any district, and take measures to prevent the spread of fires.

Dominica, the largest of the Leeward Islands, has an area of 291 square miles and about 37,000 people. It is very rugged, with elevations up to 5,000 feet, and much non-agricultural land, as well as large areas of forested land that eventually will be cleared for farming. The forest area is approximately 80,000 acres, or 43 per cent of the total area, and nearly all is owned by the crown. The forests are mostly in virgin condition, with dense stands averaging 8,000 or 9,000 board feet per acre, and some as much as 20,000 feet. They are composed of a great variety of tropical hardwoods, of which about 150 are of economic importance. There are also mangrove swamps along the coast. Because of the heavy rainfall and the rough topography, the interior forests have remained unexploited. An English company built a mill a few years ago to cut timber for the local market and for export, but was not successful and finally ceased to operate. Small amounts of dyewood (logwood) and other hardwoods are exported, as well as some firewood, while most of the construction and packing material used on the island is imported from Canada and the United States. Exports of hardwoods amounted to over 1,100,000 board feet in 1912, but with the cessation of cutting by the English company declined to only 78,000 board feet in 1913. There are no forestry laws, but the Governor has authority to forbid the setting of fires during dry periods.

Trinidad and Tobago

Trinidad, the largest of the British West Indies, except Jamaica, is situated opposite the mouth of the Orinoco River, within 7 miles of the coast of Venezuela. Its total area is 1,861 square miles, and its population about 365,000. The island of Tobago, 30 miles northeast of Trinidad, belongs to the same colony. It has an area of 131 square miles and about 25,000 people.

Extent of Forests.—The total forest area is about 1,182 square miles (756,480 acres), or 59.4 per cent of the total area. About 20,000 acres is on Tobago, the rest on Trinidad. Some of the original forest has been cleared away to make room for agriculture, which now utilizes 760 square miles, and much of the land now in forest will sooner or later be cleared.

Character of Forests.—There are two types of forest in the colony: The tidal forests, consisting principally of mangroves, which cover about 25,600 acres; and the mixed evergreen forests, which occupy the rest of the area. The evergreen forests vary considerably in composition with topography and altitude, but are all of the same general character. Trees

with diameters of from 2 to 7 feet and heights of 100 feet are common. The most important species are:

West Indian cedar (*Cedrela odorata*)
Balata (*Mimusops globosa*)
Poui (*Tecoma serratifolia*)
Locust (*Hymenaea courbaril*)
Balsam (*Copaifera officinalis*)
Cypre (*Cordia gerascanthus*)
Roble (*Platymiscium platystachium*)
Black fiddlewood (*Vitex capitata*)
Red mora (*Dimorphandra mora*)
Crappo or crapaud (*Carapa guianensis*)
Galba (*Calophyllum calaba*)
Purpleheart (*Peltogyne porphyrocardia*)
Guatecare or watercaire (*Lecythis laevifolia*)
Acoma (*Sideroxylon mastichodendron*)
Olivier (*Chuncoa obovata*)
Fustic (*Maclura xanthoxylon*)
Laurier (*Oreodaphne strumosa*)

All of the upland forests are very mixed in composition, excepting about 32,000 acres of *mora* forest, in which mora is the predominant species, associated with balata, crappo, and a few others. Of the total forest area, 512,000 acres is classed as merchantable, and 244,480 acres as not now merchantable because of inferior quality or inaccessibility.

Ownership of Forests.—Only 16,000 acres, or 2.1 per cent of the forest, is in private ownership, and most of it will be cleared for cultivation. All of the rest is crown land, of which 211,750 acres, or 28 per cent of the forest area, has been definitely reserved for permanent timber production. The balance, 528,730 acres, consists mostly of land that may eventually be cleared for agriculture, although much of it will remain under forest for many years.

Annual Growth, Annual Cut, and Losses.—The annual increment on the state forests (reserved and unreserved) has been roughly estimated at 21,734,000 cubic feet, or 30 cubic feet per acre on all except a few thousand acres. The annual cut from state forests is estimated at 2,440,000 cubic feet, of which 540,000 cubic feet is timber, and 1,900,000 cubic feet firewood. Annual losses are very small, being estimated at 1,734,000 cubic feet, chiefly from decay and waste, with only 15,000 cubic feet destroyed by fires. The net annual increment over cut and losses is 17,560,000 cubic feet, or seven times the present cut.

Exports and Imports.—Exports, consisting almost entirely of cedar, average about 152,000 cubic feet a year. Before the war, Holland, Germany, and Austria took most of it, but now Holland, the United States, and the United Kingdom take the greater part. Small amounts of mora have been exported. Imports averaged (1907-1918) 889,500 cubic feet,

of which 6,800 feet was hardwoods, chiefly from British Guiana, and 882,700 feet softwoods, of which three-fourths came from the United States and the rest from Canada. An important part of this was in the form of slack staves and heading, for asphalt barrels.

Domestic Consumption.—The consumption of lumber in Trinidad is very large compared with most of the Latin American countries. In 1914 it was estimated at about 102 board feet per capita, consisting of:

	Bd. ft.
Yellow pine (U. S.)	9,013,000
White pine (U. S. and Canada)	1,676,000
Hemlock (Canada)	420,000
Spruce (Canada)	202,000
Scotch pine (Baltic)	67,900
Hardwoods (Guiana and Venezuela)	79,700
Native hardwoods	4,732,000
Total	16,190,600

The average total consumption of timber is 1,277,500 cubic feet, and of firewood 1,900,000 cubic feet, or 3,177,500 cubic feet altogether. This is only 8.2 cubic feet per capita, which is low in comparison with some neighboring countries. The consumption of fuelwood and charcoal in Trinidad is unusually low, because of the abundant local supplies of petroleum, which furnish cheap fuel.

Lumber and Wood-Using Industries.—Data regarding sawmills and other industries are very fragmentary. There is a match factory, using from 30,000 to 40,000 cubic feet of wood a year in producing 60,000 gross of matches. The principal consumer of lumber is the petroleum industry. There are about 120 miles of standard-gauge railroad, and a considerable mileage of narrow-gauge lines on sugar plantations.

Forestry Legislation and Forest Policy.—Practically all of the forest being crown land, it is under control of the Governor, who may make regulations providing for its sale, lease, or reservation, and for granting licenses for timber and other products both within forest reserves and on unreserved crown land. There are also certain restrictions upon the tapping of balata trees on private land. The agitation for forest conservation began about 1880, but little was done until 1900, when a forester was appointed, and the selection of forest reserves commenced. In 1920, there were 330.85 square miles of reserves, designed for conservation of water supply, maintenance of atmospheric humidity, protection from winds, and production of timber. Planting was begun in 1908, and up to the end of 1919, 825 acres had been planted, principally to cedar, cypre, poui, balsam, locust, and teak. Growth is extremely rapid, some of the teak being 60 feet high and 11 inches in

diameter within seven years after sowing. These plantations are made on land already forested with inferior timber, after clearing away the existing trees. About 6,000 acres of forest has been covered by improvement cuttings, designed to promote the reproduction of the more desirable species, and this area is being extended at the rate of 1,200 acres a year. Advice is given to private forest owners, to whom seeds and planting stock of valuable species are sold at cost. A few companies and individuals have made small plantations of cedar, mahogany, and other trees. Since 1911 there has been a small net revenue from the Forest Department, although neither expenditures nor income are more than a small fraction of what they would be if the whole area were under active management.

Secondary Forest Products.—The mangrove bark industry has developed since 1915. About that year shipments of the bark began to be exported to the United States. At first most of it originated in the Orinoco delta region of Venezuela, but later on arrangements were made to exploit Trinidad mangrove.

Other minor products are balata gum, of which 1,809 pounds was exported in 1914 and 8,235 pounds in 1915, and rubber, of which about 5,000 pounds was exported in each of these years. Small quantities of divi-divi pods have also been exported.

The Probable Future.—The colony has a large surplus of hardwood timber, and can export considerable quantities, but the supply of softwoods is not adequate to meet domestic needs. It is believed, however, that excellent substitutes for the imported softwoods can be grown, with proper management, and that eventually such timber will be produced in sufficient quantity to supply the demand. These substitute species are considerably superior in durability to the woods now imported.

Windward Islands

The Windward Islands consist of St. Lucia, St. Vincent, Grenada, and the Grenadines.

St. Lucia, the largest, is 233 square miles in area and has 54,600 inhabitants. It is very mountainous, and only 20 per cent is under cultivation. Most of the rest is either forest or "ruinate," cut-over land reverting to forest. More than one-fourth of the total area, covering the central part of the island, is practically untouched tropical forest, belonging to the crown. In 1886, the total forest area, not including "ruinate," was estimated at between 50,000 and 60,000 acres, or between 33 and 40 per cent of the island. It is probably not much smaller now. Balata is especially abundant, and other important common trees include various species of *Sapotaceae* and *Lauraceae.* Logwood is abundant, and was formerly exported to a much greater extent than it has been recently.

During the period 1893-1896, average annual exports of logwood were 5,100 tons, or about 180,000 cubic feet. Just before 1915, average exports were only about 1,000 tons a year. Satinwood is the only timber regularly exported now, and the quantities are small.

Regulations adopted in 1899 provide for control over further alienation of crown forest lands. The Governor-in-Council may proclaim any crown land a forest reserve, and appoint commissioners to deal with regulation of cutting. Some reserves have been established, one of them embracing over 3,300 acres. Cutting of timber at elevations above 1,500 feet is forbidden, except under special license from the Governor-in-Council.

St. Vincent is about 130 square miles in area, with a population of 50,000. There is a central north and south mountain range, with numerous spurs on the west side, most of which is heavily forested, except at the north end, where the forest was destroyed by the eruption of Soufriere in 1902. Most of the forest land, which comprises about 20,000 acres, or 24 per cent of the island, belongs to the crown. In 1912, all crown lands above 1,000 feet elevation were declared forest reserves, also all timber within 33 feet of streams on crown lands. The protection of watersheds is extremely important, because of the heavy rainfall and steep slopes, with valuable agricultural land at lower elevations. Islands under the same administration as St. Vincent are Bequia (4,422 acres), Union (2,600 acres), Cannouan (1,694 acres), Mustique (1,257 acres), and Mayreau (600 acres), with a combined population of about 4,000. They are practically destitute of trees, all of which were cut many years ago for firewood and charcoal. St. Vincent exports small amounts of firewood to neighboring islands (855 cords in 1912 and 833 cords in 1913), and small quantities of logwood to Great Britain (45 and 82 tons in 1912 and 1913). Domestic requirements for fuelwood are supplied locally, but most of the construction lumber and box material is imported. The values of wood imports in 1912 and 1913 were $43,500 and $56,800, respectively, representing an average of probably 150,000 cubic feet a year.

Grenada has an area of 76,548 acres (nearly 120 square miles). Dependent to it are Carriacou (8,467 acres) and 20 or more small islets of the Grenadines group. The total population is approximately 71,600. About 11 per cent of the main island, or 8,500 acres, is forested. The forests are mostly confined to the higher hills, and at least half belong to the crown. The Grenadines have no forests. The Forestry Ordinance of 1906 created a Forestry Board, and provided for the establishment and maintenance of "rain reserves" around sources of springs and rivers, and "forest reserves" on higher slopes or ridges, where timber production is the best use for the land. Provision is also made for acquiring

private land where necessary. Much of the privately owned land is in fairly large estates, whose owners are interested in maintaining forest cover on ridges to protect their cacao plantations against the wind, as well as to prevent erosion. Small amounts of logwood and of firewood are exported, and some lumber and shooks are imported. Domestic consumption is not large, however, aside from fuelwood, because most of the dwellings are palm-thatched huts, and fence posts are live trees which last indefinitely.

Trees of the British West Indies.—Scattered over more than a thousand miles, both in a north and south, and in an east and west direction, the number of tree species in the British West Indies is very large, including several hundred of economic importance. A few of them are listed below:

TABLE 302.—PRINCIPAL TREES, BRITISH WEST INDIES

Acoma, acomat, mastic, or bois hete (*Sideroxylon mastichodendron*) is a large tree, fairly common in Trinidad and the Lesser Antilles. The wood is hard, dense, light brown in color, and weighs 66 pounds per cubic foot. It is very durable and makes excellent fence-posts, and is also used in general construction and cabinet work.

Almond or amandier (*Terminalia catappa*) occurs on most of the islands. It is fairly large, has brownish wood slightly resembling mahogany, weighs 56 pounds per cubic foot, and is used for furniture, finish, and construction.

Angelin or cabbage-bark (*Andira inermis*) is a large tree common on most of the islands. It has hard, strong, durable wood, which lasts well under water, and weighs 58 pounds per cubic foot. It is used for piling, bridge timbers, mill work, wheels, and general construction. It is brown in color, with dark streaks, giving it somewhat the appearance of walnut, and is a good furniture wood. The Jamaica wood, identified as *A. jamaicansis*, is considerably lighter, corresponding to oak or teak.

Balata, bullet-tree, or bully-tree (*Mimusops globosa*) reaches diameters of 4 to 6 feet and a height of 120 feet. The wood is dark reddish brown, hard, and durable, splits well, weighs from 65 to 70 pounds per cubic foot, and is used for ties, posts, bridges, and general construction. The tree yields the valuable balata gum. It is one of the most important trees in the region, and occurs on most of the islands. A related species, naseberry bullet-tree (*M. sideroxylon*) is somewhat similar, but heavier (74 pounds per cubic foot). It is used for construction in exposed situations, flooring, furniture, turnery, waterwheel shafts, shingles, and spokes, and occurs in Jamaica. *Bumelia retusa* is also called balata or bully-tree in Dominica, and is put to similar uses.

Balsa, corkwood, or down-tree (*Ochroma lagopus*) occurs in Trinidad, Jamaica, and the Windward Islands, where it grows very rapidly and attains large size. Its soft white wood is used as a substitute for cork, its bark yields a rope fiber, and the down from the fruit is used to stuff pillows. The specific gravity of the wood is about 0.12.

Balsam (*Copaifera officinalis*) is a medium-sized tree with hard, heavy, dark brown wood, which is tough and durable but fairly easy to work. It weighs about 60 pounds per cubic foot. It is used for car building, vehicles, staves, and cabinet work. Trinidad and Lesser Antilles.

TABLE 302.—PRINCIPAL TREES, BRITISH WEST INDIES—*Continued*

Bastard cedar (*Guazuma tomentosa*) has light wood, easy to work and split, used for staves and carriage panels, and very generally for building. It occurs in Jamaica. A related species, bois d'orme (*G. ulmifolia*), is used in Dominica for oars, spars, staves, and lumber.

Bitterwood or Jamaica quassia (*Picrasma excelsa*) is used locally for interior work. It is the quassia of commerce, 2,702 tons having been exported from Jamaica in 1908.

Bloodwood or ironwood (*Laplacea*, or *Haemocharis, haematoxylon*) has very hard, heavy, durable, fine-grained wood of a deep red color. It is used for building, mill work, and turnery, and could be substituted for boxwood. Jamaica and Lesser Antilles.

Brasiletto (Brisiette of Dominica?) (*Peltophorum brasiliense* or *P. linnaei*) is a fair-sized tree, with tough, elastic, durable, red or orange colored wood, used for spokes, cabinet work, and construction. It is one of the best timbers of Jamaica.

Bois contrevent (*Lucuma multiflora*) reaches 4 feet in diameter. It is used for furniture and construction. Lesser Antilles.

Bullet or bully-tree (*Dipholis montana*—mountain bullet; *D. nigra*—red, black, or cherry bullet; and *D. salicifolia*—white bullet) has heavy, hard, close-grained durable wood, used for beams, water wheel axles, and general construction. *D. nigra* weighs 71 pounds per cubic foot, but is easy to work and is used for furniture. *D. montana* is one of the most widely used local construction woods in Jamaica. All three are Jamaican trees.

Cedar or West Indian cedar (*Cedrela odorata*) is widely distributed and one of the most generally used woods of the West Indies. It weighs from 28 to 39 pounds per cubic foot, is fairly soft, easy to work, strong, of attractive appearance, and resists termites. It is used for shingles, furniture, and lumber, and some is still exported. It reaches diameters of 5 to 6 feet, with 70 to 80 feet of merchantable length.

Cedar, red cedar, or juniper (*Juniperus bermudiana*, *J. bahamensis* or *J. lucayana*, and *J. barbadensis*) occur in the Bermudas, Bahamas, Jamaica, and several other islands. The wood is used for cabinet and ornamental work, for some construction, and for pencils. Except in Bermuda, where it is practically the only forest tree, cedar is becoming scarce.

Ceiba, silk-cotton tree, or fromager (*Eriodendron anfractuosum*) is a widely distributed large tree, occasionally 10 or 12 feet in diameter, with soft, rather perishable wood, much used for dugout canoes. Its fruit yields kapok, used in stuffing mattresses.

Cocus wood or West Indian ebony (*Brya ebenus*) is a small tree with very heavy (77 to 87 pounds per cubic foot), fine grained, hard wood. The dark brown to black heartwood takes a high polish. It is used for turnery, handles, and cabinet work. In the year ending March, 1908, 555 tons was exported from Jamaica. Jamaica and Cuba.

Crabwood, crappo, or crapaud (*Carapa guianensis*) occurs in Trinidad (and British Guiana). It is a fairly large tree, with reddish, durable wood, weighing only 42 pounds per cubic foot, and easy to work. It is abundant, and much used for furniture and building. The seeds yield oil.

Cyp or cypre (called rosewood in Dominica) (*Cordia gerascanthus*) reaches 2 to 3 feet in diameter and 70 to 90 feet in height; has moderately hard, strong, yellowish brown wood, weighing from 36 to 45 pounds per cubic foot, easy to work, and used for general construction, shingles, cabinet work, and especially for furniture. It is called black cypre to distinguish it from *C. sulcata*, white cypre, which is similar. Trinidad and Lesser Antilles.

Dogwood (*Piscidia erythrina*) has very hard, tough, elastic, cross-grained wood, light brown in color, and durable in water and soil. It is much used for felloes and cart frames, and for wharf piling. Jamaica and Windward Islands.

TABLE 302.—PRINCIPAL TREES, BRITISH WEST INDIES—*Continued*

Fiddlewood, also called bois cotlette in Dominica (*Citharexylum quadrangulare*), occurs in all the islands. In Jamaica, it is said to be one of the best woods, being hard, tough, close-grained, and very durable. It is used for building, vehicle construction, posts, piling, and ties. The Jamaica tree has also been identified as *Petitia domingensis*. *Vitex divaricata*, of Trinidad and the Lesser Antilles, is also called fiddlewood, lizard wood, or bois lezard. It is one of the best and most lasting woods for building, is durable in water, and weighs from 50 to 75 pounds per cubic foot. Another fiddlewood, or boxwood, is *Vitex umbrosa*, of Jamaica. Black fiddlewood (*V. capitata*), of Trinidad, is a medium-sized tree with brown wood, which is moderately hard, easy to work, and very durable, weighing 45 pounds per cubic foot. It is used for posts, building, and cabinet work.

Fustic (*Chlorophora* (or *Maclura*) *tinctoria*) is a medium-sized tree with hard, fine-grained, durable, yellow wood, weighing from 40 to 55 pounds per cubic foot, and used for cabinet work, wheel construction, and building. It is valuable for its dye, and much is exported. It occurs in most of the islands.

Galba or santa maria (*Calophyllum calaba*) is a large tree fairly common on most of the islands. Its reddish brown, moderately hard, durable wood weighs from 46 to 53 pounds per cubic foot, is easy to work, and is widely used for building, shingles, ship building, posts, felloes, and furniture; the seeds yield illuminating oil.

Greenheart, ironwood, or breakax (*Sloanea jamaicensis*) has a heavy, dark colored, dense wood, much used for outdoor construction. This is not the true greenheart of British Guiana.

Lancewood (*Bocagea virgata* or *Oxandra lanceolata*, and *B. laurifolia*) are small trees with very strong elastic wood, much used for carriage shafts, spars, and fishing rods. Much is exported. Black lancewood (*B. virgata*) is the more valuable. Jamaica.

Laurier or laurel includes a large number of species of *Aydendron*, *Nectandra*, *Ocotea*, and *Oreodaphne*—about 20 in all. Many of them make excellent lumber for construction purposes, shingles are made from several, and several are good furniture woods. Some of them occur on nearly all of the islands of the West Indies. The most important is laurier canelle (*Oreodaphne strumosa*), a fairly large tree, with yellowish brown, rather hard, durable, easily worked wood, weighing from 34 to 45 pounds per cubic foot, and suitable for most uses to which yellow pine is put.

Lignum vitae (*Guaiacum officinale*) is of moderate size, has very dense, hard, tough wood, weighing 76 pounds per cubic foot, with a crushing strength of 3.87 tons per square inch, resists termites, and is used for pulleys, machine bearings, and turnery. It occurs on most of the islands.

Locust or courbaril (*Hymenaea courbaril*) is abundant on most of the islands. It reaches 5 feet in diameter, has streaked, red-brown wood, very hard, tough, and weighs about 70 pounds per cubic foot. It is very durable in the soil, works easily, and does not split or warp readily. Is much used by wheelwrights, also for furniture, treenails, and heavy construction. The gum, called West Indian copal, is used in varnish.

Logwood (*Haematoxylon campechianum*) is a small tree with dark red heartwood, especially valuable as the source of black, violet, blue, and gray dyes. It is also used for posts and cabinet work. It grows rapidly, reaching a foot in diameter in 20 years, and weighs from 50 to 67 pounds per cubic foot. It occurs throughout most of the West Indies.

Mahoe or mahoe cochon (*Sterculia caribaea*) is a large tree with light wood which splits easily and is used for lumber and shingles, and grows in Trinidad and Lesser Antilles. Mountain mahoe or Blue Mountain mahoe (*Hibiscus elatus*) is a fairly large Jamai-

TABLE 302.—PRINCIPAL TREES, BRITISH WEST INDIES—*Continued*

can tree with light wood (34 to 47 pounds per cubic foot), dark mottled green in color, and excellent for furniture, carriages, shingles, ties, and lumber. It is also used for gunstocks and fishing rods. Seaside mahoe (*H. tiliaceus*) and mahoe piment (*Daphnopsis tinifolia*) are smaller and less valuable trees.

Mahogany (*Swietenia mahagoni*) occurs on nearly all of the islands. It varies considerably in color and texture with the locality, and weighs about 50 pounds per cubic foot. It reaches very large sizes, but is almost exhausted now, except in inaccessible localities.

Mangrove or mangue includes *Rhizophora mangle, Avicennia nitida, Laguncularia racemosa* (red, white, and black) and several others. Black mangrove is called native oak in Jamaica. Mangroves furnish posts, piles, fuel, and to some extent, building timber, and are widely distributed. Red mangrove yields tan bark.

Mora (*Dimorphandra excelsa* or *D. mora*) is a large tree, with hard, heavy, strong, tough, brown wood, weighing 65 pounds per cubic foot, which is not attacked by insects, works fairly well, and is exceedingly durable. It grows in almost pure stands on many sites, is one of the best woods for shipbuilding, and is used locally for general construction, ties, posts, and telephone poles. Trinidad and Tobago.

Olive or olivier (*Bucida, or Terminalia, buceras*) is a very large tree, used for boards and planks for general construction. The wood is durable in water. It is one of the best for shingles. Growth is rapid, and the tree is common in Trinidad, Lesser Antilles, and Jamaica. *Chuncoa obovata* of Trinidad is also called olivier. It is a fairly common large tree, with greenish brown wood, hard, durable, weighing about 50 pounds per cubic foot, and of considerable value for building.

Pimento, baywood, Jamaica pepper, cinnamon, bois d'Inde, or allspice (*Pimenta officinalis, P. vulgaris, P. acris,* or *Myrica acris*) are medium-sized trees, whose hard, heavy, durable wood is excellent for ties, poles, posts, felloes, and canes. Bay rum is made from the leaves, and the berries are used for spice, and also yield an oil. The trees are grown for their berries, but infertile ones are cut for timber. Considerable quantities of pimento canes are exported from Jamaica. Jamaica, Trinidad, and Lesser Antilles.

Pine (*Pinus bahamensis*) is a medium-sized yellow pine with wood of good quality. It is fairly hard and resinous. Bahamas.

Poui or puy (*Tecoma serratifolia*) reaches diameters of from 3 to 5 feet, and heights from 80 to 100 feet. The wood is grayish green or greenish brown, very hard, heavy, and durable, and weighs about 70 pounds per cubic foot. It is used for building construction, bridge work, and railroad ties, and is one of the best woods for posts. Another related species is yellow poui (*T. spectabilis*). Both are natives of Trinidad.

Purpleheart (*Peltogyne porphyrocardia*) is a medium-sized tree with dark purple wood, very hard, heavy, tough, and durable, but rather difficult to work. It weighs 65 pounds per cubic foot, and is used for building and cabinet work. Trinidad.

Roble (*Platymiscium platystachium*) has light reddish brown, close-grained, hard, durable wood, weighing 60 pounds per cubic foot, and used for construction, furniture and cabinet work. Trinidad.

Rosewood or mountain torchwood (*Amyris balsamifera*) is one of the most valuable cabinet woods of Jamaica. It has hard, heavy, close-grained, aromatic wood, which takes a fine polish. In Dominica it is called bois candelle. A related species, incense wood (*Amyris trinitatis*), occurs in Trinidad.

Sapodilla, called naseberry in Jamaica (*Achras sapota*), occurs on most of the islands. It has dark red, hard, heavy, durable wood, weighing about 74 pounds per cubic foot, which is rather difficult to work. It is used for construction, furniture, and

TABLE 302.—PRINCIPAL TREES, BRITISH WEST INDIES—*Continued*

cabinet work. In Jamaica, *Mimusops excisa* is also called sapodilla. It has black, hard, durable wood, used especially in outdoor construction.

Satinwood, called yellow sanders and noyer in Dominica (*Fagara flava*), is a fair-sized tree, with hard, strong, yellowish or orange-colored wood, which has a fine, even grain, satiny lustre, and aromatic odor. It is much in demand for fine furniture, paneling, and turned ware, and weighs from 51 to 68 pounds per cubic foot. Jamaica and other islands.

Spanish elm (*Cordia gerascanthoides*) weighs from 42 to 48 pounds per cubic foot, is as hard as oak and resembles walnut, and is one of the most useful woods of Jamaica. It is used for slack cooperage, posts, building, and furniture.

West Indian boxwood, or whitewood (*Tabebuia pentaphylla*), has fine, even-grained dense, hard, light yellow to brownish wood, weighing from 49 to 54 pounds per cubic foot, and used as a substitute for English boxwood in turned ware, scientific instruments, and cabinet work. Jamaica.

Whitewood, poirier, chairwood, or white cedar (*Tecoma leucoxylon*) is hard, durable wood, used for posts, piling, ship building, and outdoor construction, and grows on many of the islands.

Yacca includes Blue Mountain yacca (*Podocarpus urbanii*), mountain yacca (*P. coriacea*), St. Ann's yacca (*P. purdieana*), all native of Jamaica, and *P. salicifolia* of Trinidad. *P. urbanii* occurs in the highest mountains, where it reaches fairly large size, but is not abundant. The wood weighs from 39 to 47 pounds per cubic foot, is cross-grained and beautifully marked, and is much prized for furniture and cabinet work. *P. purdieana* is also a large, tall tree, with harder, heavier, less ornamental wood, excellent for building. *P. coriacea* resembles *P. urbanii*.

Yellow sanders, wild olive, or negresse (*Buchenavia*, or *Terminalia, capitata*) is a large tree with durable, light yellow wood which has a satiny grain, polishes well, and weighs 57 pounds per cubic foot. It is used for furniture, cabinet work and canes, and as a substitute for satinwood. Jamaica.

Yokewood, mastwood, French or Spanish oak (*Catalpa longissima*) is a large tree, with light, brownish gray wood, something like walnut. It weighs 70 pounds per cubic foot, but saws easily, and is one of the best and most useful woods for general lumber in Jamaica.

Zebra wood (*Fagara elephantiasis* or *Zanthoxylum caribaeum*) has light yellow, mottled wood, capable of taking a high polish, and much valued for furniture and cabinet work. Mountain zebra wood (*Eugenia fragrans*) is usually rather small, and is used for general construction. Jamaica.

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CUBA

Extent of Forests.—Of the approximately 28,300,000 acres of land surface of Cuba and dependent islands, only a comparatively small part is cultivated. Practically the entire island was forested 400 years ago, but the forest area has been greatly reduced by clearing for agriculture, clear-cutting for charcoal, and repeated burning to make pasturage. It has been estimated by various authorities at from 13,000,000 to 18,000,000 acres, and is now probably nearer the first figure, as considerable land has been cleared during the past few years. This is 46 per cent of the total area, and about 4.5 acres per capita.

Distribution and Character of Forests.—Except for the mountains of Pinar del Rio, in the extreme west, and considerable areas of mangrove swamps along the coasts, practically all the forests of the western half of the island have been destroyed, so that even firewood is hard to get. In the eastern half, however, from the southeastern part of Santa Clara province eastward to the end of the island, transportation facilities have been lacking and the topography is more difficult, with the result that much of the forest still remains, either in virgin condition or lightly culled for special products. The Isle of Pines is still largely forested, and most of the small keys along the coasts are wooded with palms or mangrove thickets.

The principal types of forests are: (a) coastal forests, composed of many species of palms and various tropical hardwoods on drier sites, and of various mangroves on swampy sites, which are relatively extensive; (b) mixed tropical forests, which comprise the bulk of the tree growth of the island, and contain several hundred species; (c) pine forests, which cover considerable areas in the Sierra de los Organos in Pinar del Rio, in the northern part of the Isle of Pines, and in eastern Oriente province.

In the virgin hardwood forests the trees reach large diameters, 3 or 4 feet being common, with some 6 feet, while heights are seldom more than 125 feet. Among the larger trees are cedar, mahogany, jobo, ocuje, sabicu, jucaro, and baria. There are comparatively few trees per acre of merchantable size, however, and these are of 40 or more species on any given tract, which makes systematic exploitation difficult. One lumberman in Oriente province is reported to cut 119 different species

for the local market. Stands of the better quality are estimated to contain from 3,000 to 5,000 board feet of saw logs per acre, besides considerable quantities of tie and post timber and cordwood.

In the more accessible districts most of the valuable hardwoods have been cut, and the predominating trees are palms, of which there are 30 or more species. Most of these are of comparatively low value for timber, but are much more valuable standing, for their nuts, bark, and leaves. In many localities, stands of palms are both extensive and fairly dense. On dry slopes there is an open type of forest composed principally of rather short, limby trees, among which various species of *Leguminosae* are prominent.

The pine forests contain some cedar (*Juniperus* sp.), with hardwoods in coves and along streams, but are predominantly composed of pine of two or three closely related species, and resemble the yellow pine forests of the southern United States. Except in Pinar del Rio, they have not been exploited much until comparatively recently, save for some turpentining which was done on the Isle of Pines during the American Civil War. In Pinar del Rio, however, most of the accessible merchantable pine timber was cut over a number of years ago, but some second-growth followed lumbering. Trees of another family of conifers—several species of *Podocarpus*—occur in the mountain forests of several localities.

Ownership of Forests.—In 1905, the public forests were reported to comprise 1,226,454 acres, including keys and coastal belts of mangrove which had never passed into private ownership. This area was distributed among the different provinces as follows:

	Acres
Oriente (Santiago)	519,194
Santa Clara	307,910
Pinar del Rio	148,200
Matanzas	113,620
Camaguey (Puerto Principe)	88,130
Habana (Including Isle of Pines)	49,400
Total	1,226,454

In 1912, the area of state forest was reported to be 1,926,000 acres, or about 15 per cent of the total forest area.

Regarding the ownership of communal and private forests less is known, because many of the records were lost or destroyed at the close of the Spanish rule. It is known that there are many very large corporate holdings, held in most instances by foreign investors. Probably the bulk of the commercially valuable forest is in this class of ownership. Of the total surface of the Isle of Pines, for instance, 98 per cent is reported to be owned by citizens of the United States.

Annual Growth, Annual Cut, and Losses.—The actual net annual increment of Cuban forests is small, because they are not under management and are largely in a virgin state where growth and decay offset each other. Much of the cutting is done in connection with land clearing, and is not followed by regrowth of timber. The potential growth under forest management is considerably greater than the present annual cut, which is less than 5 cubic feet per acre of total forest land.

While no statistics of annual cut are available, a conservative estimate may be made, as follows:

	Cu. ft.
Fuel and charcoal wood	38,000,000
Posts, poles, house framing, construction timbers, furniture, vehicles, etc.	9,000,000
Railroad ties	5,000,000
Export logs and lumber	4,000,000
Total	56,000,000

This, if distributed over the entire forest area, would amount to only 4.3 cubic feet per acre, which would be much less than the net annual increment. As a matter of fact, however, a large part of it is concentrated on a relatively small proportion of the forest land, and results in a steady diminution of the forest capital. In addition, much damage is done by excessive grazing and by burning over the more or less denuded pasture lands in order to increase the area of grass land.

Exports and Imports.—Cuba was one of the first foreign sources of hardwood timber for European industries, and for nearly 400 years has exported mahogany, cedar, and dyewoods to Europe. The greater part went to Spain, with smaller amounts to Germany, Great Britain, France, and the United States. Since 1898, the United States has taken a much larger share, ranging from half to more than three-quarters of the total. During the period 1885-1898, the United States alone took 235,000 logs of mahogany, aggregating 35,700,000 board feet, and valued at over $5,000,000, besides 700,000 logs of cedar, amounting to 70,000,000 board feet, valued at $4,900,000. During the period 1907-1915, total exports of logs and lumber amounted to $15,600,000 in value, or an average of nearly $1,750,000 a year. In the fiscal year ended June 30, 1915, the exports amounted to $878,685, being made up of mahogany, 4,026,000 board feet; cedar, 10,266,000 board feet; other woods, 1,247,000 board feet; total, 15,539,000 board feet. The United States took 66 per cent of the mahogany, 84 per cent of the cedar, and 72 per cent of the other woods, while Spain took 22 per cent and England 10 per cent of the mahogany, Germany and Holland 5 and 4 per cent, respectively, of the cedar, and Panama 17 per cent of the other woods. Some cedar goes to Porto Rico, for cigar boxes. "Other woods" include lignum vitae, lancewood, dagame, sabicu, cocos or granadilla, almique, mahagua, log-

wood, and fustic. Since the war, timber exports have declined. In 1919 and 1920, the United States bought from Cuba only 3,600,000 and 4,200,000 board feet of timber. Average normal exports, based on pre-war figures, may be estimated at between 24,000,000 and 30,000,000 board feet, log scale, or approximately 4,000,000 to 5,000,000 cubic feet of logs.

Although possessed of considerable forests of yellow pine timber, as well as many hardwoods suitable for building purposes, Cuba has found it more convenient to draw upon the abundant and cheap supplies of timber furnished by the United States, and for many years has been one of the best markets for American lumber exporters. She now takes more than three-fourths of the lumber exported from the United States to the West Indies, and in 1920 took 45 per cent of all the yellow pine exported from the United States. During the period 1907-1911, average annual imports of lumber and timbers from the United States were about 120,000,000 board feet, besides shooks, staves, heading, and similar products, valued at approximately $380,000, and equivalent to about 20,000,000 board feet, and furniture and other manufactures of wood valued at $900,000. The United States supplied from 80 to over 95 per cent of the imports of lumber, ties, shooks, and staves, and the rest came principally from Canada, with smaller quantities from Spain, Great Britain, and the West Indies. The total quantity imported probably was about 13,500,000 cubic feet a year, not including finished products, such as furniture.

With the boom times resulting from the recent prosperity of the sugar industry, a great deal of new construction was undertaken and imports of lumber increased very rapidly. In 1920, imports from the United States amounted to 297,885,000 board feet of lumber and logs, besides railroad ties, shingles, staves, shooks, and similar products, equivalent to nearly 73,000,000 board feet, making a total of about 370,000,000 board feet.

Average annual imports from the United States during the calendar years 1918, 1919, and 1920 are shown in Table 303.

Estimating the equivalent quantities in board feet of the last 8 items, the total average imports were 282,600,000 board feet, or 23,550,000 cubic feet.

Domestic Consumption.—As in the other countries of tropical America, the largest consumption of wood is for making charcoal, the universal domestic fuel. Some fuel wood is used in sugar factories and other industries, but most of them import coal. Wood is very largely used for construction work on sugar and other plantations, both for the plant buildings and for workmen's dwellings. Much wood is used for piling and wharves, and the 3,200 miles of common-carrier railroad, together with an almost equal mileage of narrow-gauge plantation roads,

use large amounts of ties and lumber. The extensive cattle grazing industry requires much wood for fenceposts. The fruit industry uses large quantities of shooks, and distilleries require many barrels. Considerable native and foreign timber is used in making vehicles, railway cars, furniture, sash, doors, flooring, and interior trim. The total normal annual consumption is estimated to be 65,500,000 cubic feet, 60 per cent of which is fuel and charcoal wood. This is equivalent to 22.6 cubic feet per capita.

TABLE 303.—ANNUAL IMPORTS INTO CUBA FROM THE UNITED STATES

Kind of product	Quantity	Value
Logs and round timbers:	*M board feet*	
Yellow pine	414	.....
Fir	2	.....
Other hardwoods	85	.....
softwoods	66	.....
Hewn and sawed timbers:		
Longleaf pine	6,465	.....
Other softwoods	569	.....
hardwoods	49	.....
Lumber—Boards, planks, deals, scantlings:		
Cypress	2,847	.....
Fir	7,406	.....
Redwood	369	.....
Spruce	894	.....
Pine—white	5,687	.....
longleaf	192,852	.....
shortleaf	2,239	.....
other	4,262	.....
Other softwoods	785	.....
Gum	781	.....
Oak	124	.....
Poplar	432	.....
Other hardwoods	361	.....
Total	226,689	.....
All other lumber	.....	$47,202
Railroad ties (number)	509,657	.....
Shingles (M shingles)	272	.....
Box shooks	.....	838,414
Staves (number)	6,465,375	.....
Heading	.....	113,277
Cooperage and other shooks (number)	313,023	.....
Sash, doors, blinds, moldings, etc.	.....	102,099

The Lumber and Wood-Using Industries.—Lumbering has long been one of the important industries of Cuba, and still is, particularly in the Isle of Pines and in the two eastern provinces, Oriente and Camaguey. Most of the timber accessible to railroads and to streams large enough to float rafts has been cut, and as there are few roads in the forested districts, transportation by ox-cart is too costly to make systematic exploitation possible. Considerable railroad extension has been undertaken within the last few years, however, and much land has been cleared, so that the cut of timber has tended to increase. There are a number of sawmills, on both the main island and the Isle of Pines, and some are fairly good up-to-date mills, though none is of very large capacity. In the larger towns there are saw and planing mills and sash, door, and trim factories, which resaw and finish the imported rough lumber as well as some native lumber. Other industries of some importance are cigar-box, furniture, and vehicle manufacture, car-building, and boat-building. The packing box and cooperage industries import most of their materials, but use some native woods.

Forest Management and Legislation.—In general, Cuba has taken no interest in the permanency of her forest resources. Cutting has been done in a very wasteful manner, and much more serious have been the repeated fires, which have gradually reduced the area of standing timber and at the same time prevented regrowth on cutover lands. There is a Division of Forestry, which has supervision over the public forest lands, but it apparently does very little in the way of administering these lands, other than to collect fees for timber and other products cut from them.

Secondary Forest Products.—Although several Cuban trees yield gums and resins, little use has been made of them. The yellow pines are rich in resin, and some turpentine was made at the time of the American Civil War. The industry was later discontinued, but within the last few years has been started again on the Isle of Pines. In 1915, Cuba imported turpentine, pitch, and rosin to the value of almost $150,000, of which 80 per cent came from the United States and most of the rest from Mexico.

Several of the palms, and some other trees, yield fibre used for cordage and various other purposes. Exports of fibres from 1907 to 1915 averaged about $85,000 in value, going mostly to Germany. Dyewoods include logwood, fustic, and several minor species. Small amounts have been exported at intervals, but the trade is not important, and the same may be said of the exports of tanning materials, such as mangrove bark.

The Probable Future.—Unless steps are taken within a very few years to conserve and perpetuate her forests, Cuba will rapidly become more and more dependent upon outside sources for timber. With the exhaustion of the virgin longleaf pine of the southeastern United States,

she will have to get most of the better construction timber from the Pacific Coast, unless Mexico and Central America can supply the demand, which seems hardly likely. Undoubtedly, a much larger area will be put under cultivation than is so used now, but nevertheless there will remain many millions of acres which can and should produce timber. While most of the Cuban woods are very heavy and hard, and are not suited for making low-priced construction and box material, it probably will be possible to supply much of the requirements for that class of timber from the local pine forests, supplemented by some of the faster growing soft "hardwoods," which would be admirably adapted for the purpose if proper methods for seasoning and utilizing them were developed. On the other hand, the supply of local woods suitable for furniture, cabinet, and ornamental work, and various special uses, will always be more than sufficient for the domestic requirements, and will continue to support an export trade of some importance.

Cuban Woods.—Out of nearly 400 species of native trees about 200 reach commercial size, and many of them are used to a greater or less extent on the island. Only about a dozen have ever been established in foreign markets. Among the species of considerable economic importance are the following:

TABLE 304.—PRINCIPAL TREES, CUBA

Acana (*Labourdonnaisia albescens*) is abundant, reaches 3 feet in diameter, and has heavy, fine-grained, dark red wood, which is easy to work and very durable in moist situations. It weighs from 75 to 80 pounds per cubic foot. It is used for construction, especially in exposed situations.

Almacigo (*Bursera gummifera*) is an abundant tree of fair size, with light, soft wood (weight about 25 pounds per cubic foot) used for boxes, matches, excelsior, and probably also suitable for paper pulp. It is something like poplar. It yields a gum of economic value.

Almendro (*Laplacea*, or *Haemocharis, curtyana*) is fairly abundant, has dense red wood, somewhat softer than mahogany, and is used for cabinet work and carpentry.

Arabo (*Erythroxylum obovatum*) is a common tree of rather small size, but excellent for telephone poles and railroad ties, for which it is used.

Baria or varia (*Cordia gerascanthoides*) is one of the most valued trees of Cuba. It is widely distributed, reaches fairly large sizes, and is extensively used for building carriages, axe handles, and finish. The wood is dark chestnut brown, light in weight (from 38 to 50 pounds per cubic foot), and strong, durable, and easy to work. Several other species of *Cordia* are also valuable woods.

Caguairan, quiebrahacha, or ironwood (*Copaifera hymenaefolia*) is an abundant, fairly large tree, with very hard, heavy, durable, dark red wood, much used where great strength or durability are essential, such as posts, piles, dock work, ties, and heavy machine foundations. Weighs about 80 pounds per cubic foot, and is a good substitute for lignum vitae.

Caimitillo (*Chrysophyllum oliviforme*) has very strong, elastic, reddish yellow wood, used for rafters, carriage shafts, handles, hoops, and furniture.

Caoba or mahogany (*Swietenia mahagoni*) reaches large size in Cuba, and is of especially good quality. Although the more accessible supplies suitable for export have been

TABLE 304.—PRINCIPAL TREES, CUBA—*Continued*

nearly exhausted, considerable remains in the interior. The mahogany from the lowlands is less durable and lighter in color and weight than that from the uplands. For local use, the two sorts are usually distinguished, but for export they are not. The wood is used for construction, interior finish, furniture, fenceposts, railroad ties, and fuel. According to one estimate, the remaining stand is about 150 million board feet.

Caobilla (*Croton lucidum*) is a fair-sized tree, abundant near the coast, and used for boards and furniture. Its light red wood slightly resembles mahogany, but is less strong and durable. It weighs 50 pounds per cubic foot.

Cedro (*Cedrela odorata*) is common throughout the island, reproduces easily, and grows rather rapidly to large sizes. Its wood has more uses than any other in Cuba, and large quantities are exported.

Ceiba or seiba (*Ceiba pentandra* or *Eriodendron anfractuosum*) is a very large tree with soft light wood, not much used now but a possible substitute for pine if carefully seasoned. It yields silk cotton or kapok.

Cenizo or guayacan blanco (*Pithecolobium obovale*) has compact hard wood, used for spokes.

Cerillo, cera amarilla, or macagua de costa (*Exostema caribaea*) is an excellent wood, extensively used for cabinet work and turning. It weighs about 58 pounds per cubic foot.

Cocuyo or cocullo (*Bumelia nigra*) reaches good size, is fairly common, and is much used in cart construction and building. It has hard, elastic, yellowish wood, which is fairly easy to work, durable in the soil, and weighs 70 pounds per cubic foot. Cocuyo de sabana (*Bumelia retusa*) is similar.

Cuajani (*Prunus occidentalis*) is a large tree with hard, heavy wood, used for furniture and cabinet work. It weighs about 50 pounds per cubic foot.

Cuero (*Guettarda rigida*) has excellent wood, used for posts and building. It is yellowish, very elastic, and weighs about 64 pounds per cubic foot.

Cuia, cuya, or jocuma blanca (*Dipholis salicifolia*) has hard red wood, very durable in water, and used for docks and naval construction.

Dagame (*Calycophyllum candidissimum*) is one of the most abundant trees of Cuba, and considerable is exported, besides an extensive local consumption for building, spars, axles, spokes, and agricultural implements. The light yellow wood, somewhat like boxwood, weighs from 55 to 64 pounds per cubic foot, is very tough and durable, and works easily.

Ebano real, ebano carbonero or Cuban ebony (*Diospyros tetrasperma*) is a very valuable cabinet wood, but it is comparatively rare and small. It weighs about 75 pounds per cubic foot. There are one or two other species of *Diospyros* in Cuba.

Encino or Cuban oak (*Quercus virginiana, Q. virens, or Q. cubana*) is a liveoak, fairly common in Pinar del Rio and the Isle of Pines. It is used for building and vehicles, and its bark for tanning.

Granadillo or West Indian ebony (*Brya ebenus*) furnishes one of the best woods of Cuba. It is widely distributed, but nowhere abundant, and is seldom more than a foot in diameter. The heartwood is nearly black, and is used for handles, canes, musical instruments, and fine cabinet work.

Guaguaci or yamagua (*Guarea trichilioides*) is a fairly large tree belonging to the same family as mahogany, which it resembles.

Guasima (*Guazuma tomentosa*) has light, but strong and elastic wood, used for barrel staves.

Jaboncillo (*Sapindus saponaria*) is very abundant, and its wood is excellent for buildings and carts.

TABLE 304.—PRINCIPAL TREES, CUBA—*Continued*

Jagua (*Genipa americana*) has greenish yellow, hard, durable, elastic wood, weighing about 60 pounds per cubic foot, and used for spokes, canes, and similar articles.

Jaimiqui (*Mimusops jaimiqui* or *Byrsonima lucida*) has very strong, hard wood, weighing about 60 pounds per cubic foot; used for general carpentry and construction.

Jiqui (*Bumelia horrida*) has hard, dark brown wood, somewhat like walnut in appearance. It is very tough and durable, and makes excellent spokes, ties, telephone poles, and fenceposts. It weighs about 75 pounds per cubic foot. Ties and posts of jiqui are reported to be sound after more than 60 years' use.

Jocuma prieta or amarilla, ebano amarilla, or caguani (*Sideroxylon mastichodendron*) has very strong, tough, hard wood; used for furniture and general carpentry. It weighs about 65 pounds per cubic foot.

Jucaro prieto, black jucaro, or arare (*Bucida*, or *Terminalia*, *buceras*) has dark red or almost black wood, which is very hard, heavy, and resistant to decay and insects. It is almost teredo-proof, and is much used for wharf piling and railroad ties, being exported to Europe for ties. It is also used for spokes. The tree reaches 3 or 4 feet in diameter and 60 to 80 feet in height in about 50 years. It is fairly abundant in southeastern Cuba. Weighs 65 pounds per cubic foot. A closely related species, jucaro mastelero or yellow jucaro, is less durable and somewhat lighter, but is used for ties, axles, millwork, and naval construction.

Lirio morado (*Plumeria obtusa*) yields excellent wood for cabinet work and construction. It is yellowish in color with a violet tinge, and weighs about 54 pounds per cubic foot.

Maboa (*Cameraria latifolia* and *C. retusa*) furnish light hard woods of excellent quality, used for building, furniture, handles, and posts. The first is used in naval construction. The wood weighs about 30 pounds per cubic foot.

Majagua or mahagua (*Hibiscus tiliaceus*, *Paritium elatium*, or *P. tiliaceum*) is one of the best known Cuban woods, and some has been exported. The tree is fairly common, although the best has been cut in accessible places. The wood is greenish or bluish, hard, and takes a fine polish. It is used for furniture, cart tongues, farm implements, boats, and gunstocks. It is very easy to work, and weighs only about 45 pounds per cubic foot. The bast fibres are used for making rope.

Mangle colorado (*Rhizophora mangle*) is very abundant in the coastal region. Used for construction, firewood, and tan bark. Mangle negro (*Avicennia nitida*) has excellent dark yellow wood, weighing about 75 pounds per cubic foot.

Ocuje or santa maria (*Calophyllum calaba*) is a very abundant large tree, the wood of which has many of the properties of mahogany, is reddish brown, straight-grained, strong, and very durable, but fairly light (46 to 52 pounds per cubic foot) and works well. It is extensively used for building, car construction, bridge planks, wagon beds, ship timbers, shingles, furniture, axles, spokes, felloes, piles, and ties. The United States has imported it from Mexico and Central America for years. On one large tract in Camaguey province, ocuje is estimated to compose 60 per cent of the stand.

Palo santo, guayacan, guayacancillo, or lignum vitae (*Guaiacum officinale*) is fairly common in the remote districts of southern Cuba, where it reaches considerable size. *G. sanctum* is a smaller tree, and is now rare.

Pino or yellow pine includes several species, variously identified by different writers. That in eastern Cuba, identified as *Pinus cubensis*, does not occur in the west, while those native of Pinar del Rio and the Isle of Pines (*P. caribaea* and *P. tropicalis*, or *P. terthocarpa*) do not occur in eastern Cuba. All are resinous and of commercial value.

TABLE 304.—PRINCIPAL TREES, CUBA—*Continued*

Roble amarillo (*Citharexylum lucidum*, and *Ehretia* sp.) are hardwoods used for general construction, vehicles and ship timbers.

Roble blanco (*Tabebuia pentaphylla*) has hard, grayish yellow wood, much used for construction. Roble real (*Tecoma longiflora*) is also of considerable importance.

Roble guayo (*Petitia poeppigii*) has hard, rose-colored wood, much used for naval construction. It weighs about 56 pounds per cubic foot.

Sabicu, jigue, moruro de costa, or chocolate mahogany (*Lysiloma formosa* or *L. sabicu*) is abundant and widely distributed, and reaches sufficient sizes to yield logs 36 inches square and 30 to 40 feet long. The wood is dark chestnut brown, hard, heavy, strong, fairly easy to work, and resists decay and insects. It is used for shipbuilding, docks, millwright work, posts, furniture, and general carpentry, and makes good veneer for ornamental work. It weighs about 56 pounds per cubic foot. It has been exported to England, Spain, and the United States, for use in furniture and shipbuilding. It is an excellent mahogany substitute.

Uvero (*Coccoloba uvifera*) is abundant near the coast. It has dark red, hard wood, much esteemed for fine cabinet work. Another species, uvero macho or yarua (*C. retusa*) is similar. It occurs in pure stands over small areas. These woods are sometimes called rosewood.

Yaba or yava (*Andira inermis*) is common in southeastern Cuba, where it reaches diameters exceeding 3 feet. The wood weighs from 54 to 58 pounds per cubic foot, is reddish brown with lighter streaks, is hard, tough, strong, durable in dry or moist situations, and very difficult to split. It resists insect attacks, and is extensively used for piling, bridge timbers, ship frames and planking, house building, wheelwright work, furniture, and turned ware.

Yana (*Conocarpus erectus*) is a mangrove of considerable value for naval and land construction, as well as for charcoal.

Yaya, or lancewood, includes several more or less similar species (*Oxandra* or *Bocagea lanceolata*, *O. laurifolia*, and *Asimina rhombifolia*) which are comparatively small trees with light-colored, straight-grained, elastic wood, widely used for fishing rods, carriage shafts, spars, turnery, and canes. It is exported to several countries.

Zapote or ñispero (*Achras sapota*) yields wood very good for general construction. It weighs about 72 pounds per cubic foot.

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DUTCH WEST INDIES—CURACAO

The Dutch West Indies, or the Colony of Curaçao, include the islands of Curaçao, Bonaire, and Aruba, which lie about 60 miles north of the coast of Venezuela, and Saba, St. Eustatius, and the southern part of St. Martin, in the Leeward Group, nearly 200 miles east of Porto Rico. All are practically without forests, although there are areas of scattered leguminous trees, including divi-divi (*Caesalpinia coriaria*) and a few others, on Curaçao, which has one-half of the total area and 60 per cent of the population.

The only wood produced in the colony is a small quantity of firewood, used locally. Houses are built of rock and cement, and such framing and flooring as is used is imported from the United States. Very small quantities of hardwoods are imported from Venezuela and Colombia, principally for schooner knees. A few native huts are built of gin cases from Holland. The only wood-using industry is the building of boats and small schooners, for which imported material is used altogether. The total imports just before the war were about 1,500,000 board feet of American softwoods, principally yellow pine, with a little spruce and

white pine, and 250,000 board feet of South American hardwoods. Coal is imported for fuel, and probably some charcoal is made from native trees. The total consumption of wood in all forms is estimated at 350,000 cubic feet, or approximately 6 cubic feet per capita for the whole colony.

Much of the export trade of northwestern Venezuela goes through Willemstad, the capital of Curaçao, and is transshipped there. Consequently, considerable quantities of cabinet woods, mangrove bark, and divi-divi pods are sometimes credited to Curaçao although they do not originate there. Exports of divi-divi pods produced within the colony average about 1,400 tons a year.

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FRENCH WEST INDIES

The French West Indies include the colonies of Guadeloupe and Martinique, in the Lesser Antilles. Guadeloupe consists of two islands, separated by a narrow channel, with a total area of 619 square miles and 212,000 population, and the colony includes also the small islands, Desiderade, Marie Galante, Iles des Saintes, St. Bartholemy, and the northern half of St. Martin, the aggregate area of which is a little over 100 square miles, with 30,000 population. Martinique has an area of 380 square miles and 195,000 population.

Extent and Character of Forests.—The smaller islands and the eastern part of Guadeloupe (Grand Terre) are practically treeless, except for scattered trees in fields or along the roads. The western part of Guadeloupe, Basse Terre, is mountainous and has considerable tree growth, mostly in scattered groves or woodlots, with some continuous forests on the mountains, which reach an elevation of 4,900 feet. Martinique is also thickly populated and its land is nearly all devoted to agricultural use. The total forest area of Martinique is estimated at 42,500 acres, besides scattered growth such as is found on the other islands. This is equivalent to 17 per cent of the area of the island, and 0.22 acre per inhabitant. About the same proportion of Basse Terre is forested, or 40,000 acres, which is 0.16 acre per inhabitant of the colony.

Martinique was entirely covered with forest when discovered in 1493, but the forests were destroyed rapidly after it was occupied, in 1635, and

wood for building had become comparatively scarce by 1750. In 1901 there remained 55,000 acres of forest, which was being destroyed at the rate of 1,000 acres a year. The eruption of Mont Pelee in 1902 destroyed much of the forest on the northern end of the island, but it is restocking, along with some formerly cultivated areas which were abandoned at that time. The principal cause of deforestation is the cutting of wood for charcoal, which has been practically the only domestic fuel.

The forests are similar to the other tropical forests of the region, being composed of a large number of hardwood species, among which are mahogany, cedar, logwood, ceiba, ironwood, evergreen oaks, locust (courbaril), and palms. They are located on the steep mountain slopes and summits, and are comparatively difficult of access.

Annual Cut, Imports, and Consumption of Wood.—The total annual cut on Martinique probably amounts to about 2,000,000 cubic feet, practically all charcoal wood. About the same quantity is cut on Guadeloupe. The annual growth is estimated at 2,500,000 cubic feet.

Practically all of the construction material used on the islands is imported, most of it being yellow pine from the United States and Canada. Small quantities of hardwoods are imported from the United States and from other islands of the West Indies. Agriculture and rum-distilling, the principal industries of the colonies, require large quantities of box shooks and barrel staves, most of which are imported from the United States. The narrow-gauge railways used on the sugar plantations import several thousand ties each year, principally from other parts of the Caribbean region. Some charcoal is imported from St. Lucia. Total imports of Martinique average between 3,000,000 and 4,200,000 board feet of lumber, of which from 85 to 90 per cent is yellow pine, 10 per cent white pine, and most of the rest spruce. In 1917, the imports were about 8,500,000 board feet of lumber, 50,000 cubic feet of ties, and 350,000 cubic feet of shooks and staves, or a total of approximately 1,100,000 cubic feet. Normally, imports probably total about 700,000 cubic feet. Guadeloupe imported only about one-third as much lumber as Martinique, before the war, and about three-fourths as many staves and shooks, the total of all wood amounting to probably 400,000 cubic feet. Both quantities and values of wood imports increased greatly with the increasing prosperity of the sugar planters. The total value of wood and manufactures exported from the United States to the French West Indies rose from $324,000 in 1913, to $1,300,000 in 1919. Small quantities of logwood were formerly exported to France, but this trade is no longer important. The total domestic consumption of wood in all forms is approximately 2,700,000 cubic feet for Martinique, or nearly 14 cubic feet per capita, and 2,400,000 cubic feet, or 10 cubic feet per capita, for Guadeloupe.

Forestry Legislation.—As early as 1848 a decree was promulgated to regulate the cutting of wood and the manufacture of charcoal in Martinique, with the object of preventing deforestation. It was followed by other decrees and investigations, but apparently none was effective. A forest code, patterned after those of Algeria and Réunion, was considered by the local assembly in 1913, and it is reported that the French Senate has passed (in 1922) a law providing for regulation of the private forest lands of the island. This, however, has not yet taken effect. In 1909 there were formed a "Société forestière Martiniquaise des Amis des Arbres," composed of private forest owners, to encourage forestry, promote tree planting, reduce the consumption of domestic charcoal, and encourage importation of charcoal. This organization obtained options on forest lands near Fort de France, the capital, with the object of preventing their deforestation.

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HAITI

Extent of Forests.—Data regarding the forests of Haiti are very fragmentary. It is estimated that of the total area of 11,072 square miles, including islands, about 60 per cent, or 4,250,000 acres, is covered with forest. This is slightly less than 2 acres per inhabitant. Originally the whole country was forested. Clearing is not going on rapidly now, except for the temporary native clearings, which soon revert to forest.

Character and Distribution of Forests.—Haiti is a very mountainous country, with elevations reaching to over 10,000 feet, including the highest peak in the West Indies. There are three or four distinct types of forest, including the mangrove belt along much of the coast; the evergreen tropical forest of the valleys and mountain slopes where rainfall is heavy, principally on northern exposures; the dry tropical forest of the semi-arid districts, composed of open stands of rather short, crooked trees, many of which shed their leaves during the dry season; and the pine forests of the higher mountains near the Dominican boundary.

The forests near the coasts have been cut over repeatedly for more

than 400 years, but much of the area has restocked naturally, although the composition has probably changed considerably during that period, and there is little timber of value except for firewood. There are large areas of untouched virgin hardwoods in the interior, however, and practically no pine has been cut.

Character of Ownership.—Little is known concerning the ownership of the forest lands of Haiti, but much of the interior forest is believed to be still in public or communal ownership. Small ownership by actual residents is encouraged, and with the comparatively dense and fairly evenly scattered population, it is probable that a good deal of the forest land is in small private holdings.

Annual Growth, Annual Cut, and Losses.—The annual growth in the Haitian forests just about balances the cut and losses from fire and other causes. No statistics of the amount cut are available, but it is known that the consumption of lumber is relatively large and, except for the settlements near the coast, is not supplied by imported timber. The total average cut under normal conditions is probably not far from 3,000,000 cubic feet of construction material for domestic use, 1,500,000 cubic feet of cabinet and dyewoods for export, and 20,000,000 cubic feet of fuelwood, making a total of 24,500,000 cubic feet.

Exports and Imports.—For many years logwood has been one of the chief commodities exported from Haiti, and in spite of the large volume of exports is still abundant over most of the country. During the decade or more just before the World War, the competition of synthetic dyes restricted the market for logwood, and natural reforestation and growth replenished the accessible supply, so that it was able to meet the heavy demands that developed during the war. There is still much virgin logwood forest in the interior of the country, and it is stated that the supply can withstand a heavy drain for many years, without serious depletion.

Mahogany was formerly exported in much greater quantity than now. The supply which can be reached easily is almost exhausted, after 400 years of exportation, although there is considerable left in the interior. Exports of logwood and mahogany at various times during the last 80 years are shown in Table 305.

More or less lignum vitae is exported in some years (6,172,853 pounds in 1915), and at various times small quantities of cedar, whitewood, fustic, and other hardwoods have been exported. In 1917, the export of fustic amounted to 111,000 pounds, of all other hardwoods (except logwood) 2,026,500 pounds, and of charcoal 76,873 pounds. The total exports now average about 1,500,000 cubic feet and go mostly to the United States, although Europe takes considerable logwood.

The coast cities use large quantities of yellow pine lumber from the United States, with small amounts of other kinds. During the period 1892-1896 average imports of lumber from the United States were about 13,500,000 board feet (1,125,000 cubic feet), besides $280,000 worth of furniture and other wooden products. The volume of imports has fallen off considerably since then, being only a little over 3,000,000 board feet in 1917. Under normal conditions, average imports now would probably be about 6 million board feet, or 500,000 cubic feet.

Domestic Consumption.—A very large proportion of the houses in Port au Prince and other large towns are of frame construction, while the dwellings of the rural population are built of upright poles and palm thatch. There are only 114 miles of railroad. The universal domestic fuel is wood or charcoal, and the electric lighting plants of Port au Prince, Cape Haitien, and other towns generate their power by the use of wood fuel. The total consumption of wood for all purposes is probably at least 23,500,000 cubic feet or 9.4 cubic feet per capita.

The Lumber and Wood-Using Industries.—The lumber industry is still very primitive, most of the work being done by hand. There are practically no roads, so that timber is brought out from the interior with great difficulty. None of the rivers is navigable, excepting the Artibonite, which can be navigated at high water by small boats for a few miles above its mouth. It was reported in 1917 that there was not a modern sawmill, planing mill, or wood-working plant equipped with modern machinery in the republic. What little furniture and other wooden products are manufactured are made in small shops, mostly by hand.

TABLE 305.—EXPORTS OF LOGWOOD AND MAHOGANY, HAITI

Year	Exports of logwood	Exports of mahogany	Year	Exports of logwood	Exports of mahogany
	1,000 lbs.	*1,000 bd. ft.*		*1,000 lbs.*	*1,000 bd. ft.*
1845	68,182	7,904	1882	137,320	62
1859	88,178	2,690	1883	264,135	246
1860	104,321	2,264	1890	190,861	34
1861	105,757	1,659	1891	165,423	35
1862	167,006	2,442	1892	114,543	9
1863	116,669	2,017	1905	112,000	146
1864	153,235	2,370	1906	119,000	1,700
1878	186,960	135	1914	54,519	Not given
1879	180,667	143	1915	65,600	Not given
1880	321,730	71	1916	136,927	Not given
1881	286,402	75	1917	56,759	Not given

Forestry Legislation.—So far as known there have been no attempts to conserve the forest resources of the republic or to legislate in any way concerning the forests.

Secondary Forest Products.—Other than the dyewoods (logwood and fustic) which have been treated above, there is the bois jaune, a rather rare tree which produces a red dye. Gum guaiacum, from lignum vitae, is exported in small quantities for medicinal use. Divi-divi is common in the semi-arid region, especially near the southeastern coast, but is used only a little locally. It should form an important source of tannin. Mangroves are abundant along much of the coast and furnish some tanning material for local use, besides being an important source of charcoal wood. Mangrove bark also might be exported in considerable quantities. The pines of the interior mountain districts are very rich in resin, and when transportation facilities are developed may form the basis of an important naval stores industry.

The Probable Future.—The forests of Haiti, as those of many other countries in the region, are waiting for the building of roads and railroads in order that they may be fully exploited. They probably will always be more than sufficient to supply local needs for timber, after they become accessible, and will continue to export cabinet woods and dyewoods. The forested area will undoubtedly decrease considerably as the population grows and agriculture develops, for much of the forest land is excellently suited for raising coffee, sugar, cacao, tobacco, and other crops.

Trees of Haiti.—The following are a few of the many valuable trees of Haiti:

TABLE 306.—IMPORTANT TREES, HAITI

Bayarondes or bayahonda occurs in the semi-arid districts.

Bois jaune is the source of a red dye, resembling cochineal. It is rather rare.

Cedar (*Cedrela odorata*) occurs in rather limited quantity in the interior. It is now not very common near the coasts.

Divi-divi (*Caesalpinia coriaria*) bears pods which have a high tannin content. It is fairly common in the drier districts, but little utilized.

Fustic (*Chlorophora* or *Maclura tinctoria*) is not very abundant, but is exported to some extent for dyewood.

Lignum vitae (*Guaiacum officinale*) occurs in the dry districts, where it is a rather small, crooked tree. During the war considerable quantities were exported. It is the source of gum guaiacum, also exported in small amounts.

Logwood (*Haematoxylon campechianum*) is well distributed over almost the entire country. It often forms pure stands, or thickets, over limited areas. Its growth is rapid, enabling the species to hold its own in spite of long-continued heavy cutting.

Mahogany or caoba (*Swietenia mahagoni*). The mahogany from the island of Santo Domingo was long considered to be the best, and still is much sought after. Most of the larger trees have been cut, however, and the logs which are produced now are generally rather small. It is reported that there is some larger timber in the inaccessible parts of the interior. Mahogany is widely used locally for general purposes.

TABLE 306.—IMPORTANT TREES, HAITI—*Continued*

Mangroves, including several species, are abundant along most of the coast, and form an important source of domestic fuel, as well as yield tanbark for local use.

Pine (*Pinus occidentalis*) occurs in the mountains, chiefly in the eastern part of the country, near the Dominican border. It is a hard resinous pine of medium size and is suitable for construction lumber of good quality, as well as being a potential source of turpentine. Being inaccessible, it has not yet been exploited.

Whitewood has been exported in small amounts, for cabinet purposes.

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PORTO RICO

Porto Rico, with its dependent islands, Mona, Vieques, Culebra, Caja de Muertos, and other smaller ones, has a total area of about 3,435 square miles and a population of 1,300,000. The island is very mountainous, with a central range and many spurs averaging over 3,000 feet in elevation, and reaching a maximum of 4,398 feet. Yet, because of the dense population, most of the land that is capable of being cultivated has been cleared, so that more than 60 per cent of the total area is crop and pasture land.

Extent and Ownership of Forests.—The forests, which originally covered almost the whole island, have been almost all cut during the more than 300 years since exploitation commenced. Considerable areas were cleared for agricultural use, and heavy over-cutting of the non-agricultural areas has destroyed most of the forest. In 1916 the total area of timber and brushland was reported to be 421,530 acres. Mangrove swamps covered about 20,000 acres additional, making the total forest area 20.1 per cent of the land surface. Only about 110,000 acres, however, or 5 per cent of the total land area, is saw-timber forest. The area per capita is 0.32 acre of forest land or 0.09 acre of saw-timber forest.

A comparatively minor part of the land in Porto Rico is held by small owners, but most of the forest land is held by larger private owners. The Luquillo National Forest, set aside in 1903, comprises 12,443 acres of former Spanish crown land. In addition, about 3,000 acres formerly under control of the insular government was also put under the control of the United States Forest Service in 1917, and about 15,000 acres of mangrove swamps were proclaimed Insular Forests in 1918. The total area

of Insular Forests in 1922 is about 40,000 acres. About seven-eighths of the forests of the island, therefore, are in private ownership.

Character of Forests.—The mangrove forests occur mostly on the northeast, east, southeast, and southwest coasts, with the largest continuous areas in the San Juan bay district. There are four principal species, common in the other parts of the West Indies and Caribbean region: *Rhizophora mangle, Avicennia nitida, Laguncularia racemosa,* and *Conocarpus erectus.* Most of the mangrove forests have been cut over repeatedly for charcoal, and the trees are small and the stand per acre light.

There are considerable areas of dry, open forest in the southwestern part of the island, composed of small trees such as divi-divi, acacias, and other *Leguminosae.* The rest of the forest area is covered with typical evergreen tropical forest, although most of it is now broken up into small areas and with repeated culling has lost its original character. Only about 20,000 acres of virgin saw-timber forest remains, in the highest mountains where it has not been possible to take the timber out. There are many trees or groups of trees scattered over the agricultural land for shade and wind breaks, and these furnish considerable fuel and timber for local use.

Of the National Forest, 5 per cent of the area is bottom-land, bearing the best merchantable timber; 30 per cent, classed as "slopes," contains fair stands of merchantable material; 50 per cent "upper slopes," contains palms and scattered merchantable trees; and 15 per cent is peak and ridge land with short, scrubby, unmerchantable trees.

The total stand of timber on the island was estimated a few years ago to be approximately 207,664,500 cubic feet, classified as follows:

	Cu. ft.
Saw-timber	4,592,500
Cordwood on saw-timber lands	91,850,000
Cordwood on other lands	111,222,000

There is probably considerably less than this amount now.

Annual Growth, Annual Cut, and Losses.—The average annual growth over the entire woodland area has been estimated at 10 cubic feet per acre, or 4,415,300 cubic feet in all, as compared with a possible growth three times as great. This does not include the growth of trees scattered over much of the agricultural and other land, which is considerable in the aggregate. The annual cut in 1912 was about 18,000,000 cubic feet, of which more than 80 per cent was for fuel. The population has increased considerably since then, and the total cut is probably close to 21,000,000 cubic feet. A great deal of timber formerly was wasted by the practice of "conuco" farming, or shifting cultivation on clearings where no attempt was made to utilize the material cut. This

practice, more than the actual consumption of wood, is responsible for the present denuded condition of much of the island. It has been particularly serious since the middle of the last century, when the coffee planters and others began to go back into the mountains. Now, although more of the timber cut in land clearing is made into charcoal, some is still wasted.

Exports, Imports, and Domestic Consumption.—Porto Rico exports practically no lumber or timber products of domestic origin. Imports, on the other hand, furnish a very large part of all the lumber used. Of the total about 90 per cent comes from the United States and most of the rest from Cuba, Santo Domingo, or other countries of the West Indies and Central America. Imports of lumber reached their highest figure just before the World War, amounting to nearly 55 million board feet in 1911 and 64 million board feet in 1912, besides considerable quantities of shingles and several million feet of box shooks, as well as large quantities of wooden products. The total imports during 1911-12 averaged about 5,650,000 cubic feet, not including manufactured products such as furniture. Beginning with 1914 there was a considerable decline in consumption of lumber, but it is now approaching the former level. Since 1914 the average importation has been approximately 3,150,000 cubic feet from the United States, and 350,000 cubic feet from other countries.

About two-thirds of all the wood consumed in Porto Rico is used for fuel, the total amount thus used being a little over 17,000,000 cubic feet a year, of which three-fourths is for domestic purposes. Nearly 4,000,000 cubic feet of native wood is used for furniture, vehicles, railroad ties, posts, structural timbers, and house construction. The total consumption, therefore, is 26,650,000 cubic feet, or 20.5 cubic feet per capita.

The Lumber and Wood-Using Industries.—The principal forest industry of Porto Rico is the cutting of charcoal wood and its conversion into charcoal. Methods are very crude and wasteful. Most of the charcoal wood is cut in connection with land clearing operations, but some is cut from the mangrove forests and some from the dry woodlands of the south. Such timber trees as are cut are culled out singly and whipsawed by hand, as there are few places where there is enough timber to supply a mill. There are a few small sawmills in the coast towns, which resaw imported lumber and occasionally cut up a few native hardwood logs.

One of the largest factories on the island in 1912 was a cigar box factory, which used about a million board feet a year of imported cedar. There are a few small furniture, vehicle, and boat building shops, using native woods, and some small trunk factories and match factories which consume imported wood.

Forestry Legislation.—Several old Spanish laws provided for tree planting and the maintenance of forest cover, but so far as known were never effective. In 1903 the remaining public land in the Luquillo Mountains was set aside as a National Forest. The Board of Commissioners of Agriculture, created in 1911, has taken considerable interest in forestry. Within the past few years several areas of mangrove and other forests, still in possession of the insular government, have been reserved as Insular Forests. The Forest Law of 1917 created an Insular Forest Service in the Department of Agriculture and Labor, which has charge of the Insular Forests, besides carrying on investigative and educational work. The appropriations for this Service are about $30,000 a year.

The Probable Future.—The total area of forest land in Porto Rico may be somewhat extended, by reforesting some of the steeper mountain land which is poorly adapted to agriculture and whose reforestation will be essential for maintaining and regulating the flow of streams used for power or irrigation. The yield per acre of the forest lands can be greatly increased, and steps to that end may be taken within the next decade or two, but any probable increase that may result can hardly make the island self-supporting in timber. It may be possible to produce all the fuel wood, posts, poles, shooks, and other small material, as well as some construction timber and cabinet woods, but the great bulk of lumber requirements will have to be met by imports. Unless production is increased and wastes eliminated, Porto Rico will either have to adopt some other fuel than wood and charcoal or import a considerable part of what she uses.

Trees of Porto Rico.—Of the nearly 300 trees occurring in Porto Rico, the following are of considerable economic importance:

TABLE 307.—IMPORTANT TREES, PORTO RICO

Algarrobo (*Hymenaea courbaril*) is a common tree of fairly large size with dark streaked red wood, which is hard, heavy, strong, and durable, weighing 64 pounds per cubic foot, and is used for furniture, cabinet work, wagon wheels, and construction.

Almendron, almendrillo, or almond (*Prunus occidentalis*) is common. It has hard, heavy, strong, durable wood, light brown in color, and much used for furniture, cabinet work, and interior finish.

Ausubo or tortuga (*Sideroxylon mastichodendron* or *S. foetidissimum*) has hard, durable, reddish brown wood, weighing from 65 to 70 pounds per cubic foot, and fairly easy to work. It is one of the most widely used timbers of Porto Rico, especially for spokes, axles, ox-yokes, and to some extent for furniture. It makes good veneer, and can be substituted for cocobola.

Balsa, corcho, or down-tree (*Ochroma lagopus*) is fairly common, and is valuable for its light wood, its fibrous bark, and its cotton.

Caimitillo or caimito (*Chrysophyllum* spp.) have reddish brown, fine grained, heavy, hard, strong wood, very durable in the soil and used in such situations especially.

TABLE 307.—IMPORTANT TREES, PORTO RICO—*Continued*

Camasey (*Miconia* spp.) is a medium-sized tree with hard, strong, heavy, light brown wood, which is durable in the soil and much used for poles and fuel.

Capa blanca (*Petitia domingensis*), also called fiddle wood, has streaked dark brown wood, hard, heavy, and capable of taking a fine polish. It is used for cabinet work, interior finish, construction, and mill rollers.

Capa prieta or Spanish elm (*Cordia gerascanthoides* or *C. alliodora*) has strong, durable, streaked brown wood, weighing 36 pounds per cubic foot, and highly prized for furniture, flooring, interior finish, and cooperage.

Cedro (*Cedrela odorata*) is the common Spanish cedar, formerly abundant in Porto Rico, but now almost gone. Considerable quantities are imported for the manufacture of cigar boxes.

Ceiba or cotton tree (*Ceiba pentandra* or *Eriodendron anfractuosum*) is a very large common tree, with soft, light-brown, fairly strong but perishable wood, weighing 28 pounds per cubic foot, and used for boats and cheap lumber. It yields kapok.

Granadillo or yellow sanders (*Buchenavia capitata*) is a very common fair-sized tree, with wavy-grained, hard, heavy, strong wood, used for furniture and fancy carpentry.

Guacima (*Guazuma ulmifolia* and *G. tomentosa*) are very common trees with rather soft, tough, fairly durable wood, weighing about 35 pounds per cubic foot, used for oars, posts, staves, heading, and fuel.

Guama and guava (*Inga laurina* and *I. vera*) are extensively planted to shade coffee plantations. The wood is used for fuel.

Guaraguao, muskwood, or acajou (*Guarea trichilioides*) is one of the more valuable trees of the island, but is becoming scarce. The wood is reddish brown, hard, strong, durable in the soil, and resembles cedar and mahogany. It is used for general carpentry, cabinet work, and vehicles, and weighs about 38 pounds per cubic foot.

Higuerillo, lizard wood, pendula, or fiddlewood (*Vitex divaricata*) has white, hard, durable wood, weighing 50 pounds per cubic foot, used for lumber for interior and exterior construction.

Hueso or palo de vaca blanco (*Drypetes alba*) has fairly heavy, strong, tough, cross-grained yellow wood, used for hubs and for fuel, and weighs 60 pounds per cubic foot.

Jobo or hog plum (*Spondias lutea* or *S. mombin*) is very common, with soft, fairly strong, light-colored wood, weighing about 30 pounds per cubic foot, and much used for posts and fuel.

Jucare, hucar, or ucar (*Bucida buceras*) has brownish, hard, heavy, strong wood, durable in water, and somewhat resembling elm. It weighs about 62 pounds per cubic foot. Used for shingles, mallets, shelves, and boat knees.

Laurel sabino (*Magnolia splendens*) has olive-brown, straight-grained wood resembling that of *Liriodendron tulipifera*. It works well, is fairly hard, strong, and very durable, and is one of the best native timbers. It is used for boards and furniture, and weighs about 38 pounds per cubic foot. Mauricio (*Magnolia portoricensis*) is similar.

Maga (*Thespesia grandiflora*) has chocolate brown, fine-grained wood, hard, moderately heavy, strong, and very durable in the soil. It is largely used for shelving, foundations, and furniture. It weighs 42 pounds per cubic foot.

Mahagua, majagua, blue or mountain mahoe (*Hibiscus tiliaceus*) has dark bluish-green, straight-grained wood, which is very strong, tough, and durable, weighs 47 pounds per cubic foot, and is largely used for railroad ties, shingles, flooring, cabinet work, and furniture.

TABLE 307.—IMPORTANT TREES, PORTO RICO—*Continued*

Mammee apple, or mamey (*Mammea americana*) is a very common, fairly large tree, with hard, heavy, very durable, reddish brown wood, weighing 61 pounds per cubic foot, excellent for house building.

Mangle or mangrove includes *Rhizophora mangle* (mangle colorado), *Avicennia nitida* (mangle blanco, black mangrove, or chifle de vaca), *Laguncularia racemosa* (mangle blanco or white mangrove), and *Conocarpus erectus* (mangle botoncillo). All four are chiefly valuable for fuel, but the first two are used also for fence posts, foundations, and piling. The bark of red mangrove is used locally for tanning.

Moca, angelin, or cabbage-bark (*Andira jamaicensis*) is a common tree with cross-grained, strong, tough, hard, reddish yellow wood, especially durable in water, and used for piling, bridges, boats, hubs, flooring, and general construction. It weighs from 47 to 55 pounds per cubic foot.

Mora or fustic (*Chlorophora tinctoria*) is common in the southwest part of the island. The strong, hard, durable yellow wood weighs from 45 to 62 pounds per cubic foot, and is used for spokes and furniture. It is a valuable dyewood.

Motillo (*Sloanea(berteriana*) is a fairly large tree with strong, tough, durable, white wood. It is very hard and rather heavy, and is used for building and fuel.

Ortegon (*Coccoloba rugosa*) is a fairly large tree with purplish, fine-grained, strong, tough wood, used for construction timber. The sea-grape or uva del mar (*Coccoloba uvifera*) is a shorter tree of large diameter, with dark figured wood, weighing 65 pounds per cubic foot, and much esteeemed for cabinet work. There are several other species of *Coccoloba* in Porto Rico, all of which are useful for building or cabinet work.

Palms of several species are abundant and useful. The most important are *Cocos nucifera*, coconut palm, whose wood is hard, heavy, very durable in the soil, and used for posts, piles, and canes; *Acrista monticola* (palma de sierra or yagua del monte), abundant in the mountains, whose wood is split into boards; and *Oreodoxa caribea* (palma real, yagua, or royal palm), which is very abundant and used for many purposes.

Palo santo, guayacan, or lignum vitae (*Guaiacum officinale*) occurs along the southern coast. The wood weighs from 77 to 85 pounds per cubic foot. It is becoming scarce. *Guaiacum sanctum*, a much smaller tree, was formerly abundant in Porto Rico, but is rare now.

Pata de caba (*Triplaris* sp.) has wood similar to that of algarrobo.

Roble includes *Tecoma pentaphylla* (roble blanco or West Indian boxwood) and *T. leucoxylon* (roble prieto, or whitewood). The wood is white, fine-grained, weighs 52 pounds per cubic foot, and is widely used for general purposes, piling, ox-yokes, and boat building.

Santa maria (*Calophyllum calaba*) is a rather common large tree, much used for carpentry work, furniture, shingles, felloes, and boats.

Satinwood (*Fagara flava*) is not very common now, and the remaining trees are rather small. It is used for furniture and cabinet work. Several other species of *Fagara*, known as espino, occur in the island. Their wood is similar to satinwood. *Simaruba tulae* also is known as West Indian satinwood, and is much like *Fagara*. It is very highly prized for furniture and interior finish, and is rare now.

Tabanuco or candlewood (*Dacryodes excelsa* or *D. hexandra*) is a large tree, occasionally reaching diameters of from 3 to 5 feet, and occurring in almost pure stands. It is one of the most valuable trees of the island for building purposes. The wood is brown, fairly hard, and strong, but not durable when exposed. Its physical properties are similar to those of yellow poplar (*Liriodendron*). Stained, it is sold as mahogany.

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SANTO DOMINGO OR DOMINICAN REPUBLIC

Extent of Forests.—The forested area of the Dominican Republic is now about 9,500,000 acres, or 77 per cent of the total land surface, and from 10 to 12 acres per inhabitant. Originally almost the whole country was forested, except for the savanna lands of the San Juan valley, but four centuries of shifting cultivation and attendant fires have reduced the area to what it is now. Although clearing is not proceeding very rapidly now, the forested land is gradually being reduced and may eventually come down to about 5,500,000 acres, which is probably to be considered as the area better suited for timber growth than for cultivation.

Character and Distribution of Forests.—There are three principal types of forest in the republic: dense tropical hardwoods, evergreen or partly so; the open forest of the semi-arid regions, mostly of deciduous trees; and pine. A distinct sub-type of the tropical forest is the belt of mangroves or palms which occurs along the northeast and southeast coasts and in some of the other sheltered bays, as at Monte Cristi and Barahona.

The "moist" tropical forest occurs at all elevations from sea level to 9,500 feet, especially in the eastern part of the country and in the mountains of the western part, on northern and eastern exposures. It occupies about 58 per cent of the total forest area, or 5,500,000 acres. The stands are very dense, especially at the higher elevations, where the rainfall is greatest. They are composed of a great variety of trees, nearly all evergreen at the higher altitudes, but with many deciduous species lower down. At the lower elevations, also, the stands are a little more open, with occasional grassy parks resulting from natural causes or from native clearings or "conucos." The trees in the mountains average from 10 to 25 inches in diameter, with occasional larger specimens, while

those on the lower slopes are somewhat larger. This type contains mahogany, Spanish cedar, satinwood, and most of the logwood. While cutting has been going on for 400 years along the coasts and floatable streams, farther inland forests are untouched except where they have been broken by the conucos of the native farmers.

The "dry" tropical forest occurs below elevations of 2,000 feet, where the rainfall is less than 30 inches a year. It is chiefly in the northwestern and southwestern parts of the country, and occupies about 28 per cent of the forested area, or 2,650,000 acres. The trees in this type do not stand very close together, and for the most part are rather short-boled and frequently crooked. Characteristic species are fustic, lignum vitae, divi-divi, acacias, logwood, and bayahonda. This type has been cut over near the coasts and settlements for fuel and for dyewoods and cabinet woods.

Typical hardwood stands have been estimated to be composed of the species shown in Table 308.

TABLE 308.—HARDWOOD STANDS, SANTO DOMINGO.

Species	Stand per acre	Species	Stand per acre
	bd. ft.		*bd. ft.*
(1) Almacigo	6,000	(3) Almacigo	4,000
Jagua	600	Candelon	500
Bayahonda	500	Cotinilla	400
Caya blanca	500	Caya blanca	200
Candelon	500	Mahogany	50
Jobo	500	Total	5,150
Quiebra hacha	200		
Ubilla	100	(4) Almacigo	2,000
Mahogany	30	Guayacan	2 tons
Total	8,930	Bera	3 tons
(2) Almacigo	2,500	(5) Roble	500
Jobo	500	Candelon	500
Caya blanca	300	Caya blanca	400
Zapotillo	200	Jobo	300
Mahogany	100	Mahogany	100
Total	3,600	Total	1,800

The pine forest occurs at elevations between 2,000 and 9,000 feet, principally along the Central Cordillera, with a few outlying areas on the other ranges. It occupies 14 per cent of the forest area, or 1,350,000 acres. Longleaf pine (*Pinus occidentalis*) makes up 80 per cent of the

stand, on the average, but nearly all of the hardwoods represented in the other two types occur scattered in the pine forest. Another species, found only in this type, is red cedar (*Juniperus barbadensis*), which is cut for pencil wood. The pine stands on the slopes are rather open, with about 30 trees per acre more than 5 inches in diameter and averaging from 12 to 25 inches in diameter and 40 to 60 feet in height. There is very little undergrowth except grass, and little young growth of pine because of the frequent surface fires. In the coves and bottomlands the pine is of much better quality, with an average of 50 trees per acre, some of them 5 feet in diameter and from 150 to 200 feet tall. On these sites there is a dense undergrowth of pomarosa (*Eugenia jambos*), a small tree which is so dense as to prevent natural reproduction of the pine. Many of the sheltered coves in the pine area are filled with dense stands of hardwood, containing but little pine in the mixture. The stands of pine average from 2,000 board feet per acre in the east to 5,000 or 6,000 feet in the west.

The total stand of pine has been estimated at from 3 to 4 billion board feet, while there are 11 billion feet of hardwoods in the country, including all trees of merchantable size, regardless of species.

Ownership of Forests.—The ownership of land in the Dominican Republic has long been a matter of uncertainty, as there have been practically no valid titles. While considerable areas are in the hands of small individual occupants or are held in a sort of communal ownership, it is probable that the greater part of the commercially valuable forest land is owned by the government.

Annual Growth, Annual Cut, and Losses.—The annual growth just about balances the amount of timber cut or otherwise destroyed. A large part of the forest is practically in a virgin condition, while in most cases where logging has been done, only selected trees were taken out. Although considerable timber is destroyed every year in the process of clearing fields for temporary cultivation ("conucos"), practically an equal area reverts to forest at the same time. The quality of the timber is deteriorating with the process because the old clearings are frequently occupied by fast-growing species of inferior value.

Statistics regarding the annual cut are very fragmentary. The few sawmills in the republic produce about 2,000,000 board feet of lumber a year for domestic use and a great deal is sawed or hewn by hand. The total cut of saw timber for domestic purposes is probably about 500,000 cubic feet. Timber cut for export was much greater in quantity 30 years ago, when logwood exports were at their height, than now. At that time more than 1,000,000 cubic feet a year of cabinet woods, dyewoods, and construction woods was exported. Conditions have been more or less upset during the most of the last decade. It is probable,

however, that under normal conditions about 500,000 cubic feet would still be exported. The annual cut for local fencing and fuel is probably not less than 10,000,000 cubic feet, making the total cut about 11,000,000 cubic feet of wood in all forms.

Wind damage is negligible in amount, nor is there serious loss from insects or fungi, except following fires. Forest fires can not burn in the "wet hardwood" type, but do much damage in the "dry hardwood" and pine stands. This damage consists chiefly in scarring the bases of standing trees and occasionally burning them down and in destroying young growth.

Exports and Imports.—Santo Domingo, like Haiti, has exported cabinet woods and dyewoods for more than 400 years. For a long time, practically the only species exported were mahogany, logwood, and lignum vitae, with very minor quantities of others. For 300 years, mahogany shipments went to Spain, France and Great Britain; during the past century the United States and Germany have taken most of it. Not much is left now near the coast and drivable rivers, but there is said to be a great deal in the interior. Small blocks are occasionally brought out on burros and exported. Around 1890 nearly 1,000,000 board feet a year of mahogany was exported. The quantity fell off rapidly to less than 300,000 feet in 1896, and now the exports are even smaller.

Exports of logwood have been chiefly from the north coast, especially the port of Monte Cristi, and prior to the war most of it went to Europe. Now some is taken by the United States. The species renews itself readily by sprouting and grows fairly rapidly, so that there still remain abundant supplies, although some regions are practically cut clean. About 1890 annual exports of logwood were between 20,000 and 25,000 tons. The competition of synthetic dyes during the past 20 years resulted in a decreased demand for vegetable dyes, and the exports almost ceased, increasing again after 1914. In 1916 about 5,000 tons were exported.

Lignum vitae, or guayacan, is most abundant in the southern part of the country. The exportation has varied widely from year to year, amounting to 5,653 tons in 1891, 781 tons in 1897, 3,221 tons in 1912, and 1,577 tons in 1917. In 1917 almost 80 per cent of the total went to the United States, and the remainder to Porto Rico and the Danish West Indies. Other woods which have been exported in small quantities at various times are: abei, vera, fustic or mora, espinillo or satinwood, cedro (Spanish cedar), sabina (pencil cedar), jucaro, yaya, baitoa or boxwood, walnut, ebano, maplewood, rosewood, quiebra-hacha, and caya. The total exports of normal years are probably about 500,000 cubic feet.

Most of the construction lumber used in the coast towns is imported

from the United States because the pine forests of the island, which supply most of the requirements of the interior, have not been connected with the coasts by roads or other means of communication. About 8,000,000 board feet a year (670,000 cubic feet) is imported, 80 per cent of which is southern yellow pine.

Domestic Consumption.—Although houses generally have not been built of wood, there is now a growing tendency toward replacing brick and adobe with frame construction. Practically no shooks or staves are used, and the 150 miles of railroad do not consume very large amounts of wood. There are practically no wood-using industries, except for small shops supplying the limited local requirements for sash, doors, and furniture. The greatest consumption of wood is for fuel, usually in the form of charcoal, which is the universal domestic fuel. The total consumption of construction material is estimated at 1,170,000 cubic feet, and of fuel and fencing 10,000,000 cubic feet, a total of 11,170,000 cubic feet. This is between 11.7 and 14.0 cubic feet per capita.

The Lumber and Wood-Using Industries.—The net result of 400 years of exploitation has been to thin out certain species from the accessible stands, without destroying the forest. The material exported is either shipped in the log or squared, and is not sawed. Logging methods are rather primitive and little cutting for export is done except fairly near the coast or along the streams such as the Yaqui del Norte, Yuna, Orama, Macoris, and Yaqui del Sur, which are navigable for flat-bottomed boats for from 10 to 40 miles during periods of high water. The center of exploitation is the Monte Cristi region in the northwest. While some logs are floated down the streams during floods, most of them are hauled out by oxen and two-wheeled carts. Now that accessible mahogany has become scarce, some is brought out from the interior on burros. To be transported thus it has to be cut into small flitches, usually about 2 feet long by 9 inches thick and 16 to 18 inches wide. In the interior pine and hardwoods are cut for local use. There are several small steam sawmills, equipped with American machinery, in the La Vega-Santiago-Moca region of the northern interior, and two or three near the southwest coast. These saw domestic woods, chiefly pine, for local use, cutting all together not much more than 2,000,000 board feet per year. In 1917 there were 9 sawmills in the country. Considerable other material is sawed by hand or hewed. Excepting logwood, only the medium-sized trees are generally cut, because the small ones and the large ones can not be handled profitably. Logging methods are very wasteful and stumps are cut high.

There are practically no wood-using industries. Small local furniture and cabinet shops make such furniture and finish as is needed.

Forestry Legislation.—There was a law of 1874, requiring farmers who should take up new land to leave 5 per cent of it in forest, unless they planted cacao or coffee, and prohibiting the destruction of trees near springs or the heads of streams. There is nothing to indicate whether this law was ever enforced. Most farmers who have young mahogany trees on their land have been protecting them of their own accord. An executive order issued by the military governor in 1919, known as the Dominican Forest Law, provides for the designation as national forest reserves of forest lands in the mountains or elsewhere where it is essential to maintain a forest cover and to prevent fires and erosion. It also provides for an organized Forest Service, under the Department of Agriculture and Immigration. A supplementary order of 1920 designates the reserve areas, comprising nearly all of the commercially valuable mountain forests. A Forest Service was established in 1920 and a guard force organized, which was given up later because of financial stringency.

Secondary Forest Products.—Dyewoods have been discussed under the sections dealing with timber. Besides logwood and fustic, small quantities of brasilwood and cochinella, or cochineal wood, have been utilized. Mangrove also yields some dye, but has not been much used for this purpose.

Mangrove has been exploited to some extent for tanbark, about 300 tons being exported in 1916. Divi-divi pods are also exported, though probably not to the extent they might be. Almost 300 tons was shipped in 1916.

When roads are built the pine forests may become important sources of turpentine and rosin, as the native pines are very resinous. Several small attempts at developing a naval stores industry failed because of the great difficulty of getting the product to market.

The Probable Future.—About one-half of the forest area of the republic is excellent agricultural land and ultimately will be cleared for agricultural use. Something over 5,000,000 acres, however, is better adapted for growing timber than for anything else. This is principally mountain land, some of it productive, the rest less so. At least 1,000,000 acres of potential agricultural land needs irrigation, and this will require that forests be maintained on the watersheds of the important streams. Given stability of political conditions and development of adequate transportation routes, the process of agricultural development will probably proceed rather rapidly, and at the same time there will be large quantities of timber produced both for local use and for export. After this development has taken place and most of the agricultural land is occupied, the remaining forests will be able to supply domestic requirements for pine construction lumber and also for hardwoods, so

that importation of lumber will practically cease. It is not likely that there will continue to be a very large surplus, even of hardwoods, for export to other countries.

Trees of Santo Domingo.—There are said to be more than 100 trees of considerable commercial importance in Santo Domingo, although only a few of them have been used except locally. Among them are the following:

TABLE 309.—COMMERCIALLY IMPORTANT TREES, SANTO DOMINGO

Abei or abey (*Hedwigia balsamifera* ?) yields cabinet wood which has been exported.

Acacias—several species of acacia have pods with a high tannin content. They occur in the semi-arid districts.

Algarroba or locust (*Hymenaea courbaril*) has very hard, durable wood.

Almacigo or armacigo (*Bursera gummifera*) is very abundant. Its wood is soft and very light when dry, slightly resembling poplar or basswood. While it does not make good lumber, it may be used for pulpwood, matches, and interior work.

Almendron (*Terminalia catappa*, or *Laplacea* sp. ?).

Amacei or copaiba (*Copaifera officinalis*).

Anona is used for house timbers.

Ausubo (*Myrtaceae*).

Baitoa (*Phyllostylon brasiliensis*) is used as a substitute for boxwood.

Balsa (*Ochroma* sp.) is reported to occur.

Barata is used for common framing lumber.

Bayahonda (*Calliandra formosa*) is a very common tree of the semi-arid region. It averages about 6 inches in diameter and 25 feet in height, and is used locally for construction, fuel, and railroad ties. Small quantities of ties have been shipped to Porto Rico.

Bera or vera (*Bulnesia arborea*) has been exported in small quantities.

Brasil (*Caesalpinia* sp.), a dyewood, is reported to occur.

Cabima or cabilma (*Cedrela angustifolia*) is similar to cedro.

Cabomba (*Guarea* sp.) makes good boards.

Caimito or caimitillo (*Chrysophyllum oliviforme*).

Calla (caya) amarilla, calla blanca, and calla colorada have hard, close-grained wood, excellent for furniture. It is used also for ties, spokes, and building, and small quantities have been exported.

Candelon (*Colubrina ferruginosa*) is a fairly common large tree, with deep red wood somewhat resembling mahogany. It may be used for the same purposes as mahogany.

Cañafistula (*Cassia fistula*) has hard wood.

Canoewood (*Eriodendron anfractuosum*) is a large tree with soft wood, used for making dugout canoes.

Caoba or mahogany (*Swietenia mahagoni*) is fairly plentiful in the interior and is of excellent quality. Most of the trees are not very large, however. Stands with two merchantable mahogany trees to the acre are considered better than the average.

Caobilla (*Croton* sp.) resembles an inferior grade of mahogany.

Capa or capa prieto (*Cordia gerascanthus*) is used for ties, hubs, and spokes.

Capa de sabana (*Petitia domingensis*) has excellent hard wood.

Cedro (*Cedrela odorata*) is not very abundant. A little is exported. Some trees are very large.

Ceiba (*Ceiba pentandra*) is the large silk-cotton tree. Its wood is soft and fairly light.

TABLE 309.—COMMERCIALLY IMPORTANT TREES, SANTO DOMINGO—*Continued*

Cherry or membrillo (*Cerasus* (*Prunus*) *occidentalis*) is a large tree, producing valuable timber.

Cochinella or cochineal wood (*Camocladia integrifolia*) is the source of a brilliant red dye.

Coconut palm (*Cocos nucifera*) is very abundant in the coastal regions.

Divi-divi (*Caesalpinia coriaria*) occurs in the semi-arid belt. Some pods have been exported for tanning, but the more accessible supplies have been almost exhausted. There are large quantities farther back.

Ebano (*Brya ebenus*) is green or brown ebony. Small quantities have been exported. It is not abundant.

Espinillo and espino or satinwood (*Zanthoxylum* spp.) are excellent cabinet woods, of which small quantities have been exported for many years.

Fustic or mora (*Chlorophora tinctoria*) is fairly common in the southwestern dry region. Some has been exported for its yellow dye.

Granadillo (*Gymnanthes lucida*) is a cabinet wood.

Gree-gree (*Bucida* sp.) makes durable ship timbers.

Guaconejo (*Amyris silvatica*) occurs in the dry belt.

Guayacan or lignum vitae (*Guaiacum officinale*) has long been an important article of export. It is most abundant in the semi-arid regions. Trees are seldom over a foot in diameter.

Guayacancillo (*Guaiacum verticale*) is similar to the other species.

Hoja ancha is used for telephone poles.

Jagua (*Genipa americana*) has strong, hard, durable wood, used for construction and cabinet work.

Jabilla, javilla, sandbox, or possum-wood (*Hura crepitans*). It has reddish-colored, soft wood.

Jobo (*Spondias lutea*) is a large tree with soft wood of little value for lumber.

Jucaro is used for construction.

Lana (*Bombax pyramidale*) produces a vegetable wool which is exported.

Lancewood is used for buggy shafts and spars. It is fairly common.

Laurel or lourea (*Lauraceae*) makes good lumber.

Logwood or campeche (*Haematoxylon campechianum*) is abundant in both hardwood types. The best of it is now in the southern part of the country.

Majuga has a fibrous bark used for making rope.

Mangle blanco (*Laguncularia racemosa*) and mangle rojo or mangle colorado (*Rhizophora mangle*) yield tanbark, the last being the most valuable. They also make excellent fuel.

Maria, santa maria, or dalmaree (*Calophyllum calaba*) is a valuable hardwood.

Nogal or walnut (*Juglans jamaicensis*) is fairly common in the mountains in the southwestern part of the republic. It is commonly about 15 inches in diameter and 60 feet tall, but occasionally reaches 30 inches and 80 feet.

Palo blanco (*Tecoma leucoxylon*) has valuable hard wood.

Pino, pichipin, or cuaba (*Pinus occidentalis*) is a longleaf pine, with straight, clear bole, and sound, durable, resinous, hard wood, which makes excellent lumber. The sapwood will not float, but the heartwood does. There is reported to be also a shortleaf pine, chiefly in the northern range of mountains

Quiebra hacha (Dipholis nigra) has very hard wood.

Roble blanco or Dominican oak (*Tecoma pentaphylla*) is a good hardwood and fairly abundant.

Roble prieto (*Catalpa* sp.) is also a cabinet wood.

Rosewood is reported to occur in the republic, and small quantities have been exported.

Sabina or pencil cedar (*Juniperus barbadensis*) occurs in the pine forests. It commonly

TABLE 309.—COMMERCIALLY IMPORTANT TREES, SANTO DOMINGO—*Continued*

reaches 12 inches in diameter and 40 feet in height, and some trees are considerably larger. Small quantities have been exported.

Sapodilla or sapotillo, the tree which yields chicle, occurs in the republic, but its gum has not been utilized.

Turbino, a wood something like mahogany, is of local occurrence.

Ubilla is a tall, slender tree, cut for railroad ties.

Yaya (*Cordia* sp. or *Oxandra* sp.) is used for construction. Small quantities have been exported.

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THE VIRGIN ISLANDS

The Virgin Islands of the United States, formerly the Danish West Indies, include St. Croix, St. Thomas, and St. John, which are 84, 28, and 20 square miles in area, respectively, and about 50 smaller islands and rocks, none more than a square mile in area. The total population in 1917 was 26,000. Of the total area of 84,781 acres on the three larger islands, 39,448 acres was improved farm land, while woodland on farms was reported as 10,553 acres, and 14,889 acres was not included in farms but is probably accounted for by towns and villages, roads, and miscellaneous uses, with some areas of mangrove swamp. The total area of woodland probably is about 15,000 acres, or 18 per cent of the land surface. Nearly all of the original forests have been cut for lumber or charcoal, which is still the universal fuel of the islands.

The shore vegetation consists of stands of manchineel (*Hippomane mancinella*), seaside grape (*Coccoloba uvifera*), icaco (*Chrysobalanus icaco*), coconut (*Cocos nucifera*), and *Canella alba*, on sandy beaches, while on the swampy land are various species of mangroves (*Rhizophora*,

Avicennia, Laguncularia, Conocarpus) and *Bucida* sp. and *Anona* sp. St. John has the best remaining upland forest, and St. Thomas the poorest. The principal trees include species of *Calophyllum, Dipholis, Sideroxylon, Lucuma, Zanthoxylum, Nectandra, Anona, Chrysophyllum, Spondias, Eriodendron,* and *Hura.* There are still some mahogany trees, and about 50,000 cedar and mahogany trees have been planted.

About 40 native woods are used to some extent for building and furniture and many others for charcoal, but most of the construction and box lumber is imported, chiefly from the United States. Normal imports of logs, lumber, and box shooks average about 500,000 board feet a year from the United States, and possibly 100,000 feet from other sources, making a total of 600,000 board feet, or 50,000 cubic feet. The domestic cut, mostly of charcoal wood, is probably at least 300,000 cubic feet, and the annual growth is about the same, or 20 cubic feet per acre. The total consumption may be estimated at 350,000 cubic feet, or about 14 cubic feet per capita. The only forest industry of importance is charcoal making, which employs more than 100 persons.

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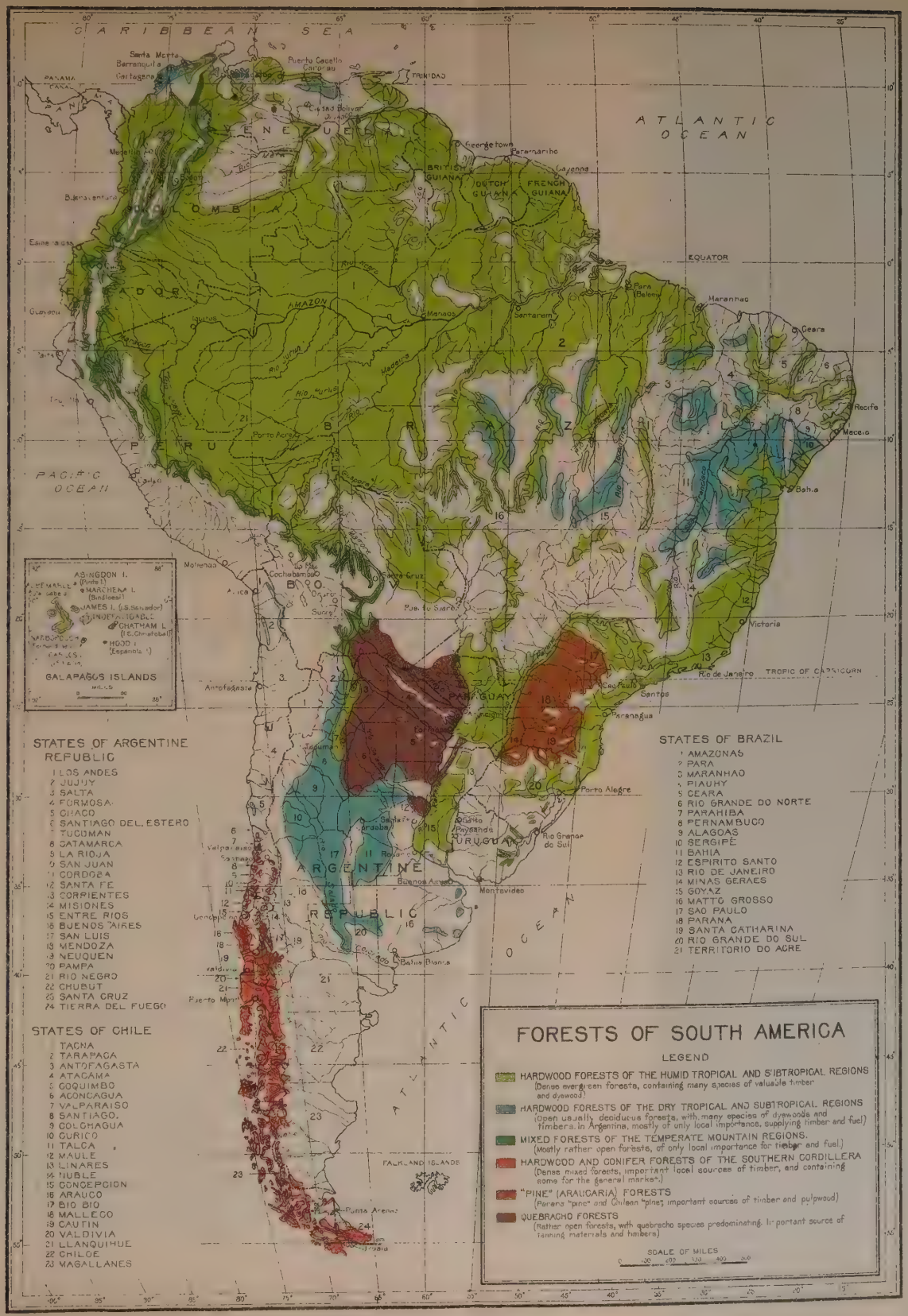
CARIBBEAN SEA
ATLANTIC OCEAN
PACIFIC OCEAN
EQUATOR
TROPIC OF CAPRICORN
Santa Marta
Barranquilla
Cartagena
Puerto Cabello
Caripano
TRINIDAD
Ciudad Bolivar
Maracaibo
Medellin
Cali
Buenaventura
Esmeraldas
Guayaquil
Tumbes
Piura
Trujillo
Chiclayo
Callao
Lima
Pisco
Arica
Iquique
Antofagasta
Mollendo
Cochabamba
Santa Cruz
Oruro
Sucre
Pue. to Suarez
Jujuy
Salta
Tucuman
Valparaiso
Santiago
Concepcion
Valdivia
Puerto Montt
Buenos Aires
Montevideo
Bahia Blanca
Rosario
Cordoba
Santa Fe
Corrientes
Posadas
Asuncion
Encarnacion
Villa Rica
Caaguazu
Paraguari
Georgetown
Paramaribo
Cayenne
BRITISH GUIANA
DUTCH GUIANA
FRENCH GUIANA
Para (Belem)
Manaos
Santarem
Maranhao
Ceara
Recife
Maceio
Bahia
Victoria
Rio de Janeiro
Santos
Paranagua
Porto Alegre
Rio Grande do Sul
Pelotas
Rivera
Melo
Rio Negro
Rio Purus
Rio Juruá
Rio Madeira
Rio Tapajoz
Rio Xingu
Rio Tocantins
Rio Araguaya
Rio Paraguay
Rio Paraná
Rio Uruguay
Rio Iguassu
Rio Doce
Rio Parahyba
Rio Grande
Rio Colorado
Rio Negro
Rio Chubut
Rio Deseado
Rio Santa Cruz
Rio Gallegos
Rio Chico
Rio Coig
Rio Chico
Rio Gallegos
Rio Santa Cruz
Rio Deseado
Rio Chubut
Rio Negro
Rio Colorado
Rio Grande
Rio Parahyba
Rio Doce
Rio Iguassu
Rio Uruguay
Rio Paraná
Rio Paraguay
Rio Araguaya
Rio Tocantins
Rio Xingu
Rio Tapajoz
Rio Madeira
Rio Juruá
Rio Purus

PLATE XIV
FORESTS OF SOUTH AMERICA

(*Facing page 666*)

CHAPTER VI

THE FOREST SITUATION IN SOUTH AMERICA

ARGENTINA

Extent and Distribution of Forests.—According to official statistics, the total area of forest land in Argentina amounts to 264,012,000 acres, which is 36.1 per cent of the land surface and 32 acres per inhabitant. This area includes some burned-over and non-restocking forest land, which, however, is relatively small in extent, and also a good deal of more or less open forest which is chiefly valuable for firewood and fencing material, but still is of considerable economic value to the regions in which it is located. The forest is very unevenly distributed, as Table 310 shows.

TABLE 310.—FOREST DISTRIBUTION, ARGENTINA

Province or territory	Forest area	Per cent forested	Province or territory	Forest area	Per cent forested
	M acres			*M acres*	
Jujuy	4,505	47.6	Misiones	6,348	86.2
Los Andes		0.0	Entre Rios	12,177	65.1
Salta	26,429	85.5	Buenos Aires	418	0.6
Formosa	9,929	37.5	La Pampa	4,730	13.1
Chaco	20,378	60.4	San Luis	15,042	81.0
Santiago del Estero	26,429	74.6	Mendoza	19,118	48.1
Tucuman	4,890	81.8	Neuquen	741	2.8
Catamarca	12,720	54.0	Rio Negro	321	0.6
San Juan	15,265	63.0	Chubut	2,470	4.1
La Rioja	19,241	79.5	Santa Cruz	494	0.7
Cordoba	34,086	78.9	Tierra del Fuego	2,062	38.8
Santa Fe	14,548	34.4			
Corrientes	11,671	54.4	Total	264,012	36.1

The great bulk of the forest is in the northern part of the country, with a much smaller area extending in a narrow belt for a thousand miles or more along the Andes in the southwest.

Character of Forests.—As would be expected in a country extending through 34 degrees of latitude and with an altitudinal range of more than

20,000 feet, the forests are very varied in composition. There are five main forest regions, some of which may be further subdivided. They are: (1) The tropical and subtropical forest of the Misiones and Mesopotamian regions, including the provinces of Corrientes and Entre Rios and the Misiones territory; (2) the quebracho region of the Chaco and adjoining districts, from the Bolivian boundary southward through Jujuy, Salta, Tucuman, eastern Catamarca, and Santiago del Estero, and east to the Parana and Paraguay rivers; (3) the subtropical forest of the Andes foothills in central Jujuy, Salta, and Tucuman; (4) the dry belt with open forest, principally of leguminous species, extending from western Salta through Catamarca, La Rioja, eastern San Juan and Mendoza, and eastward to southwestern Santa Fe, with a narrow strip through central La Pampa to southwestern Buenos Aires; (5) the mixed hardwood and coniferous forest of the Andes, extending in a narrow belt along the western edges of Neuquen, Rio Negro, Chubut, and Santa Cruz, to Tierra del Fuego.

1.—The first region includes about 3,600,000 acres of Parana pine forest in eastern Misiones, which is an extension of that of the Brazilian states of Parana and Santa Catharina. The total stand of Parana pine in this district has been estimated at 3,400,000,000 board feet. Western Misiones and most of the forested portions of Corrientes and Entre Rios have mixed hardwood forests, composed of several hundred species. Toward the east and north these forests resemble those of eastern Paraguay, while toward the south and west they are more open, with large areas of palms and open grass savannas, gradually merging into the Chaco type in western Corrientes. Among the more important trees of this region are cedar, lapacho, incienso, loro, petereby, virapita, laurel, ceibo, cebil, catigua, and ñandipa. Yerba mate, or Paraguay tea, occurs over most of Misiones.

2.—The quebracho region for the most part is flat or nearly flat country, intersected by many streams, and covered with a rather open, or in some places dense forest, broken by numerous more or less extensive open savannas or swamps. The forest begins 5 to 20 miles back from the Parana and Paraguay rivers, and extends westward in a fairly wide belt to eastern Jujuy, Tucuman, and Catamarca, and northward to southern Matto Grosso, in Brazil. From 45 to 60 per cent of the region is actually timbered. Characteristic trees are the quebrachos, of which there are several kinds. The tanning quebracho, also known as quebracho colorado, occurs chiefly in the eastern part of the region, being best developed in northern Santa Fe, where it was originally most abundant. The best and most accessible stands in Santa Fe have been cut, however, and the largest remaining supply is in Chaco Territory. Toward the north, the quality becomes inferior and the stand lighter,

but there are considerable supplies in Formosa Territory and in the Paraguayan Chaco.

The present merchantable stand of tanning quebracho is estimated as follows:

	Metric tons
Santa Fe	22,800,000
Santiago del Estero	2,000,000
Chaco	37,500,000
Formosa	9,000,000
Total	71,300,000

Other estimates have gone as high as 168,000,000 tons.

In the better stands there are about 18 quebracho trees, yielding nearly 6 tons of wood per acre of actual timber, but over most of the region there are not so many. The forests are composed of a large number of species, many with hard, durable wood which is excellent for heavy construction work, railroad ties, and fuel. White quebracho, which is much used for ties, fuel, and construction, but is not so valuable for tanning, is very abundant in the region of true quebracho, and extends farther to the west and south. Other species of importance include: lapacho, urunday, curupay, mora, palo blanco, algarrobo (several species), palo santo, cebil, ibiraro, inga, canelon, espinillo, catigua, brea, guayacan, and caranday or palma negra. Much of the timber in this region is short, with spreading crowns and more or less crooked boles of fairly large diameters, though some trees reach 100 feet or more in height and have clear, straight boles. Stands per acre, including all species, run from 2,000 to 15,000 board feet.

3.—The subtropical belt of Jujuy, Salta, and Tucuman covers the lower slopes of some of the front ranges of the Cordillera, which intercept the moisture-bearing winds from the east and cause a heavy precipitation. This forest is rich in a large number of valuable species and the growth is luxuriant. Among the important trees are cedar (*Cedrela fissilis*), tipa, laurel, cebil, palo blanco, pacará (timbo), and lapacho, and at the higher altitudes walnut (nogal) and pino blanco (*Podocarpus* spp.).

4.—The forests of the fourth region resemble those of the drier parts of the Chaco, but are generally more open and the trees are somewhat shorter. Quebracho is not commonly found, but many of the Chaco species occur, as well as a number of others. Leguminous species predominate and there are extensive areas covered with pure stands of algarrobo, tala, calden (ñandubay) and similar trees. In this region, and particularly toward its southern and western limits, the best timber occurs along the streams. In spite of the general open character of the stands and the more or less scrubby form of most of the trees, the

forests are of great economic importance to the local population, as a source of firewood, fencing material, railroad ties, and general construction wood. Among the more abundant and valuable species are calden (ñandubay), algarrobo (several species), acacias (several species), tala (two species), guayacan blanco, mistol, aguarribay, and chañar. Willows are common along the streams and reach large size.

5.—The forests of the Andes are mostly south of 36° south latitude, extending from northern Neuquen to southern Tierra del Fuego and Isla de los Estados. These forests are in very rough, mountainous country and are not one continuous body, but are broken by many areas of open grazing land or barren rocky mountains. Much of the original forest has been destroyed by fire, and has given place to more or less scrubby growth of no commercial value. Of the remaining forest, a considerable proportion likewise is of low value for timber, though its protective value is high, for the rivers which traverse the great semi-arid grazing region of Patagonia head in these mountains. Some districts, however, have good timber which not only is used locally but in some cases will be exported to other regions. Andean pine (*Araucaria imbricata*), for instance, covers an area of about 200,000 acres between 37° 20′ and 39° 40′ south latitude. The species occurs in almost pure stands, some of which are reported to run as high as 40,000 board feet per acre, with an average of 20,000 feet. The dominant pines reach 3 or 4 feet in diameter and 100 to 120 feet in height. Even more valuable, but rather scarce now, is the alerce or "larch" (*Fitzroya patagonica*). Cedar or ciprés (*Libocedrus* spp.) is fairly common and much used locally, while pino (*Podocarpus*) is another conifer of some importance. South of about 43° S., the forests are pure hardwoods, except for scattered ciprés, and the hardwoods are also important components of the forests farther north. The characteristic species are the "robles" or beeches (*Nothofagus* spp.), of which coigue is the most abundant, averaging 20,000 board feet per acre over extensive tracts. Nire is also widely distributed and is of commercial size at lower elevations, but is only a shrub on the higher slopes. Roble and rauli are more valuable, but are not common on the Argentine side of the mountains. Toward the south the principal beeches are lenga and guindo, which are cut into lumber in Tierra del Fuego and shipped to northern ports. Besides the beeches, the most valuable hardwood species is canelo or magnolia (*Drimys winteri*), which occurs principally in Tierra del Fuego. Much of the hardwood forest is overmature, and the percentage of defective material is large.

In addition to the five forest regions described, there are limited areas of woodland along the coast, especially in Buenos Aires province, along many of the rivers, and a few on low hills in the plains and pampas

region. These forests are of some local importance as sources of wood and timber, and some of them are valuable as protection forests. There are also some planted forests, principally of exotic species, in Buenos Aires Province and in the Mesopotamian region.

Ownership of Forests.—Most of the forests of Argentina are privately owned, and the bulk is owned in very large units, by corporations such as the quebracho companies or those interested in the grazing industry. In 1915 the state still owned about 15 per cent of the forest in Misiones territory, about half of that in the Chaco and Formosa territories, and four-fifths of the Andes forest, or 8.7 per cent of the total forest area of the country. The areas of state forest by territories are given in Table 311.

TABLE 311.—AREA OF STATE FORESTS, ARGENTINA

Territory	Area of state forest	Per cent of the forest area of the territory	Territory	Area of state forest	Per cent of the forest area of the territory
	acres			*acres*	
Formosa	7,904,000	79.6	Chubut	2,408,000	97.5
Chaco	8,645,000	42.4	Santa Cruz	371,000	75.1
Misiones	968,000	15.2	Tierra del Fuego	1,976,000	95.8
Neuquen	556,000	75.0			
Rio Negro	272,000	84.7	Total	23,100,000	8.7

Of the state forests, 567,000 acres, principally in the Chaco, were under lease for exploitation in 1915. The individual provinces own an unknown area of forest lands.

Annual Growth and Annual Losses.—Regarding the present annual growth little is known. Growth is rapid in the humid subtropical regions, but is slow in the Chaco and the dry forests of the northwest, and is exceedingly slow in most of the Patagonian forest belt. On the most favorable sites, coigue produces 50 cubic feet per acre per annum, but for the Andes forest in general, total growth is probably considerably less than the losses from decay and fires. Fire has been the most serious enemy of the forests of that region for at least 250 years, and not only has destroyed large areas of forest but has resulted in serious deterioration of the remainder, both by injury to the standing trees and by favoring the inferior species at the expense of the more valuable but less resistant ones. Fire damage is serious also in the dry forests of the north, where the density of the stands in many places has been considerably reduced and reproduction prevented. There is probably no

net growth in this region. In the humid tropical and subtropical forests fires are of rare occurrence, and growth probably just about balances the amount cut. For the country as a whole, then, the net annual growth is probably only a fraction of the annual cut—probably not over one-fourth, or about 50,000,000 cubic feet, which is equivalent to 0.2 cubic foot per acre of forest.

Annual Cut.—The average annual cut of lumber and construction timber is relatively small. Because of the high cost of logging, manufacture, and transportation, imported lumber has been more economical to use in all except the most remote parts of the interior of the country. In the region tributary to the Plate markets, only about one-tenth of the lumber consumed, amounting to 4,660,000 cubic feet a year, has been cut from Argentine forests, while the cut in the Andes and other interior regions is estimated at 4,190,000 cubic feet. The total average annual cut of all materials is estimated to be about as given in Table 312.

TABLE 312.—TOTAL ANNUAL CUT, ARGENTINA

Product	Cu. ft.	Product	Cu. ft.
Lumber and timber	8,850,000	Railroad ties	19,750,000
Quebracho for tanning	22,000,000	Charcoal wood	12,000,000
Posts, poles, piling, and stakes	7,200,000	Staves, spokes, spars, box-shooks, paving, match-blocks, etc	20,000,000
Firewood for domestic and industrial use and railroads	108,000,000	Total	197,800,000

Since 1914, the difficulty in getting imported coal led to a great increase in the consumption of fuel wood, especially by the industrial plants and railways. In 1913 railroads used 446,000 tons of wood fuel, while in 1917 they used 3,019,000 tons, and even more in 1920. At the same time, exports of fuel wood increased by at least 150,000 tons. The total increased cut of fuel wood amounted to at least 80,000,000 cubic feet a year, but this has not been considered in the foregoing estimates because it probably represents a temporary state of affairs. Many of the railroads are planning eventually to burn oil.

Timber Trade.—*Exports.*—Quebracho was first introduced into Europe as a tanning material in 1867, and its use on a large scale commenced in 1888, especially in Germany. The manufacture of quebracho extract in Argentina began in 1889, and is now the second in importance among Argentine manufacturing industries. It was greatly stimulated after 1913 by the high ocean freights on logs, which made it more eco-

nomical to export the extract. Since 1913, therefore, the exports of logs have tended to decrease steadily as exports of extract increased. Exports of both products since 1893 are shown in Table 313.

TABLE 313.—EXPORTS OF QUEBRACHO LOGS AND EXTRACT, ARGENTINA

Year	Logs	Extract	Year	Logs	Extract
	metric tons	*metric tons*		*metric tons*	*metric tons*
1893	63,297	.....	1907	246,514	28,195
1894	74,358	.....	1908	254,571	48,162
1895	172,949	402	1909	294,722	55,493
1896	83,266	684	1910	341,969	53,231
1897	135,675	1,205	1911	438,216	68,431
1898	188,260	1,192	1912	279,342	74,910
1899	159,376	3,172	1913	383,964	79,684
1900	239,836	5,957	1914	291,942	80,153
1901	198,919	4,310	1915	209,679	100,213
1902	245,723	9,099	1916	161,734	97,574
1903	200,201	12,040	1917	133,170	90,777
1904	252,723	20,111	1918	14,766	132,956
1905	285,897	29,408	1919	54,642	139,667
1906	230,100	30,839	1920	56,582	122,837

At first Germany took most of the quebracho logs, but the proportion going to the United States, Italy, Russia, Great Britain, Belgium, France, and other countries gradually increased, and since 1914 the United States has taken the largest share. From 1902 to 1904, Germany took about 55 per cent of the logs, the United States 16, Belgium 8, Italy 7, France 6, Russia 5, and Great Britain 3 per cent. In 1913, Germany took 38 per cent, Russia 18, United States 16, France 7, Italy 6.5, Netherlands 5, Great Britain 3 per cent, and Belgium, Austria, Spain, and Norway the rest. In 1920, about 70 per cent went to the United States and 20 per cent to Italy. The United States has generally taken a very large part of the extract. In 1902 to 1904 the United States took 57 per cent, Germany 27, Great Britain 12, and Italy, Belgium, France and Austria the rest. In 1913, the United States took 40 per cent, Germany 13, Austria 12, Great Britain 11, France 9, Belgium 8, and Italy, Spain, Netherlands, Norway, and Sweden the rest. In 1920, about 40 per cent went to the United States and 15 per cent to Great Britain.

Exports of posts, short poles, and stakes, most of which go to Uruguay, are of considerable importance. In 1888, more than 420,000 were exported, while 205,000 posts and 112,000 stakes were exported in 1912. Exports of railroad ties were of little importance until 1911, when there was a very great increase in the business. From 1911 to 1913, an average

of more than 125,000 ties a year was shipped from Argentina. Uruguay took most of them, but some went to Europe. Small quantities of firewood normally are shipped to Uruguay, but in 1917, with the shutting off of much of the coal imports, exports of firewood increased almost fifteen-fold, to 172,500 tons, and were even more in 1918. In 1912, charcoal was exported to the amount of 70,679 hectoliters. Expressed in terms of equivalent volume of wood, the total normal exports are about 17,800,000 cubic feet a year, and during the war they exceeded 20,000,000 cubic feet.

Imports.—Argentina normally imports nearly nine-tenths of the lumber consumed in the Plate River region and districts tributary to it, which use nine times as much as all the rest of the country. Total imports of lumber, logs, and timbers for several years prior to 1914 averaged approximately 446,400,000 board feet, or 37,200,000 cubic feet, of which 80 per cent came from North America and Europe and 20 per cent from South America, principally from Paraguay. With the decline in imports of softwoods from the northern hemisphere after 1914, and the development of the lumber industry in southern Brazil, Argentine imports of Parana pine rose rapidly from an insignificant quantity in 1910 to about 2,000,000 cubic feet in 1915 and 7,000,000 cubic feet in 1918. The total given above does not include imports of staves, heading, shooks, ties, shingles, wood pulp, and other products, which amount to approximately 8,600,000 cubic feet, making the total imports 45,800,000 cubic feet.

Imports of some of the more important products during 1912, with the countries supplying most of them, are shown in Table 314.

Of the total imports of wood and manufactures of wood, valued at over $25,000,000 in 1912, more than 75 per cent was entered at Buenos Aires, about 14 per cent at Rosario, 3 per cent at Bahia Blanca, 2½ per cent at La Plata, and smaller quantities at the other ports, the most important of which are Zarate (center of the paper industry) and Concepcion del Uruguay.

Domestic Consumption.—Argentina uses comparatively little wood in building houses. Floors are frequently of wood, and sash, doors, and some partitions are also made of wood. In 1909, out of 111,135 houses in Buenos Aires, only 4,526, or 4 per cent, were of wooden construction. The railroads, of which there were 22,600 miles in 1919, are among the largest consumers of lumber and timber. The steel and iron ties which originally were used in many cases are being replaced with wooden ones, and large quantities of timber are used for bridges, stations, cars, water tanks, and other construction. Much wood is also used in docks and wharves, and some for street paving. Manufacturers of furniture, vehicles, and many other wooden products use large quantities. The wine

industry is very important in several provinces, and requires a great many wooden barrels, while the meat and dairy industries use great quantities of wooden boxes. Much fencing is being done, which consumes many posts and pickets. Considerable quebracho tanning material is used in Argentina. The greatest volume of wood is used for fuel, not only for domestic purposes but also for industrial plants and railroads. The total consumption is approximately 225,800,000 cubic feet, or 27.3 cubic feet per capita. During the war it was considerably greater, because of the increased industrial use of fuel wood, and amounted to about 37 cubic feet per capita.

TABLE 314.—IMPORTS OF FOREST PRODUCTS, ARGENTINA

Product	Quantity	Per cent from
Lumber:		
White pine	47,500,000 board feet	U. S. 80, Canada 9, Great Britain 7, Brazil 3
Douglas fir	400,000 board feet	U. S. 99
Yellow pine	236,000,000 board feet	U. S. 99
Spruce	115,500,000 board feet	U. S. 45, Canada 39, Sweden 9, Austria 4
Oak	6,280,000 board feet	U. S. 77, France 6, Japan 6, Austria 5, Germany 2
Cedar	12,750,000 board feet	Paraguay 95, Brazil 5
Ash	1,250,000 board feet	U. S. 98
Walnut	100,000 board feet	U. S. 54, Italy 42
Mahogany	88,000 board feet	U. S. 30, Africa 30, England 16, France 12, Italy 10
Logs—Cedar	13,568 metric tons	Paraguay 56, Brazil 43
Veneer—Oak	12,331 square meters	U. S. 21, France 78
Walnut	630,000 square meters	U. S. 2, France 84, Belgium 12, Germany 2
Mahogany	1,447 square meters	France 100
Beams and plank	25,000,000 board feet	Paraguay 98, Brazil 2
Fence pickets	34,102,000 board feet	Australia 59, Paraguay 41
Boxes (meat, etc.)	1,315,032 boxes	Great Britain 63, Germany 19, Sweden 17
Staves and casks	937,200 pieces	U. S. 85, England 5, France 3
Other boxes	341,466 boxes	France 50, Sweden 22, Italy 12, Germany 6
Shooks	2,986 metric tons	U. S. 64, Sweden 24
Palm telegraph poles	11,600 poles	Paraguay 92, Brazil 7
Wood pulp	20,000 metric tons	Sweden 53, Germany 21, Norway 15, Russia 7
Newsprint paper	27,813 metric tons	U. S. 45, Germany 38, Sweden 8, England 5

The Lumber and Wood-Using Industries.—Forest industries are among the most important in Argentina, after agriculture and the meat industry, and support many towns as well as several railroads in the northern part of the country. The production of lumber and structural material is of less importance than that of fuel wood, railroad ties, charcoal, and quebracho extract wood. These industries together employ about 60,000 men in the woods and factories. The quebracho industry is mostly controlled by a few large companies, of which one controls the bulk of the output, while the firewood production is mostly in native hands. The major lumber and timber operations are connected with the railroads, who get out ties, bridge and structural timbers, and lumber for cars, station buildings, platforms, and even for office furniture. As most of the native woods are heavy and will not float, especially while green, cutting follows the railroads rather than the streams. Although some logging has been carried on for more than 100 years, the industry has been important only within the last 60 years. It is best developed now in Santa Fe, Chaco, Santiago del Estero, Cordoba, Tucuman, and Misiones. Logging is still conducted in rather primitive and wasteful fashion, except in the case of quebracho, which is fairly well utilized. Logs are usually squared by hand in the woods, taken out to the railroads by oxen and two-wheeled carts, and hauled by rail to the consuming centers, where they are cut up in bandmills. In the south there are very few mills, all rather small, and cutting is for local consumption only. The Argentine census of 1913 reported 305 sawmills, with a capitalization of $8,940,000 (U. S. gold) and 7,378 employees.

Among the important wood-using industries are the manufacture of: tanning extract (14 factories in 1920); vehicles, especially carts, which is carried on by several large and many small factories; furniture, which is well developed, one factory in Buenos Aires using 20 or more native woods; boxes and shipping containers, from both imported and home-grown woods; cooperage, which uses imported oak and some native species; matches; and paper, with 20 mills, of which about 5 have up-to-date equipment. Table 315 gives the wood-using plants listed by the 1913 census.

Forestry Movement and Legislation.—As early as 1607, measures were taken to protect the forests near Buenos Aires, and in 1810, 1823, and subsequent years, various decrees and regulations provided for protecting and planting forests near centers of population, and for regulating cutting on public lands. These measures seem to have had little effect. In 1903 a decree was issued providing for regulation of public forests, and this was superseded by another executive decree of October 4, 1906, which provides, among other things, that forest lands belonging to the state, and to provinces and individuals who request it, shall be put

under forest regulation. The state lands bearing commercial forests are temporarily reserved until they can be finally classified, and all wood cutting or extraction of other forest products from such reserves is forbidden, except by permission of and under regulation by the government. Moreover, it is to be the policy to acquire, subject to the granting of necessary appropriations by Congress, lands which are necessary for stream protection, prevention of erosion, protection of coasts, and fixation of dunes. Regulations are provided for exploitation of public forests, including the requirement to secure reproduction either naturally or by planting, and to insure fire protection. July 9 is set aside as a national Arbor Day.

The government has been embarrassed by inadequate appropriations, with the result that progress in forestry work has been slow, and great areas of public forest have remained unprotected. A forest survey was started in 1911, with the help of foreign experts, but has not been completed. In 1915 President de la Plaza submitted to Congress an elaborate forest bill, which provided for adequate administration of public forests as well as for forest fire protection in general and for assisting in the extension of forests in all parts of the country. This bill apparently did not become a law.

Private individuals and companies have planted considerable areas of fast-growing trees such as cottonwood, willows, eucalypts, acacias, and maritime and Monterey pines, chiefly for firewood, fence posts, and boxboards. The domestic box industry uses very large quantities of willow and poplar, grown on rotations of from 5 to 8 years on rich bottomlands. It is said that these plantations return greater profits than would agricultural crops on the same lands. The planted areas are chiefly in Buenos Aires and the Mesopotamian region of Entre Rios and Corrientes.

TABLE 315.—WOOD-USING PLANTS, ARGENTINA

Industry	Number	Number of employees	Capital invested
			U. S. dollars
Sawmills	305	7,378	8,940,000
Woodworking	736	5,903	4,843,000
Tanning extract and firewood	493	19,616	33,212,000
Furniture, trunk, and tapestry	1058	8,101	9,243,000
Wagon and carriage	1270	8,291	6,438,000
Matches	16	3,094	975,000
Paper and cardboard	11	1,901	4,923,000

Secondary Forest Products.—The production of tannin from quebracho has been discussed above. Its importance as a tanning material is indicated by the fact that for the fiscal year 1914 it formed 87 per cent of all such materials imported by the United States and 38 per cent of all used in the United States. In addition to the true tanning quebracho, several of the others are of less importance for the purpose. White quebracho has a high per cent of tannin in its foliage, but little in the wood and bark, and is not exploited for its tannin. Cebil, tipa, algarobilla, and several acacias have much tannin in wood, bark, or fruit pods, and are used locally to some extent.

During the war the manufacture of dye from algarrobo was undertaken, and some has been exported.

Argentina now imports practically all of her paper or paper pulp. The 20 mills make about 10 per cent of the newsprint, 80 per cent of the machined white book paper, and 90 per cent of the wrapping paper used in the country, but import nearly all of their raw material, except about 4,000 tons of domestic pulp made from cottonwood and willow. Chilean pine, or *Araucaria imbricata* of the Andes, has been tested and found to be excellent for paper pulp, and projects for its exploitation have been proposed. The total supply is estimated to be sufficient to make 2,688,000 tons of pulp, while the amount of paper consumed annually is equivalent to about 60,000 tons of pulp.

Many species yield gums suitable for industrial or medicinal use, but are not exploited extensively. The *Araucarias* are potential sources of resin and turpentine, but most of those products now consumed in Argentina are imported from the United States.

The Probable Future.—Argentina's large forest area and great variety of excellent woods have led some to suppose that she may eventually become an important source of supply for other regions where timber is becoming scarce. While some increase in exports of construction and cabinet woods may be looked for, it is probable that increasing domestic requirements will practically keep pace with the development of transportation which is essential for exploitation of the forests. Although only about one-third of the total area, or 253 million acres, is fit for cultivation or pasturage, only one-fifth of that, about 50 million acres, is in actual productive use now. The Andes forests never can supply permanently more than a limited local demand, and the same is true of a very large proportion of the open dry forest of the west. The forest areas in those regions and in the quebracho region are steadily shrinking from fire and cutting, while regeneration is rather uncertain and difficult, and growth slow. The humid tropical and subtropical forests of the northwest and northeast can supply greatly increased quantities of hardwoods and some softwoods for construction and cabinet work, but as they are

opened up they will merely take the place of the now more accessible forests of Paraguay and Brazil in supplying domestic requirements, and may partially meet the demand now filled by woods imported from Europe and North America. The quebracho industry can continue on its present scale for many years, but even in this case no considerable permanent increase can be looked for. It seems likely, therefore, that Argentina will continue to import softwood construction lumber, though possibly on a gradually diminishing scale, and more of it will come from Brazil and less from the northern hemisphere. At the same time, exports of hardwoods for furniture, vehicles, handles, cabinet work, and railroad ties will gradually increase.

Argentine Woods.—There are probably 360 species of trees in northern Argentina alone, of which more than 50 are abundant and of considerable economic importance. Of 260 woods described by one writer, 20 are classed as very hard, 125 as hard, 86 as medium hard, and 29 as soft. The most important ones are:

Alerce (*Fitzroya patagonica*) is a very valuable conifer of the southern Andes, but is not abundant on the Argentine side. It reaches large size, occurs in pure stands over limited areas, and has soft, light, but strong wood of excellent quality for construction and carpentry.

Algarrobo includes several species of *Leguminosae*, of which the more important are *Prosopis alba, P. nigra,* and *P. juliflora.* They are very abundant in the dry forest regions of the north and west. The wood is hard, strong, very durable, and weighs from 42 to 60 pounds per cubic foot. It is much used in construction, also for ties, paving blocks, posts, spokes, turnery, and cabinet work, and makes excellent fuel. Its bark yields tannin and medicinal gum, the fruit makes excellent forage, and a coffee-colored dye is also produced.

Brea (*Parkinsonia aculeata* or *Caesalpinia praecox*) is a very abundant small tree of the dry regions. While of little value for lumber, it makes good fuel, and also yields a gum, similar to gum arabic, which is exported regularly.

Canelo, magnolia, or winter's-bark (*Drimys winteri*) is a common tree of Patagonia and Tierra del Fuego. Its wood is strong, stiff, easy to work, and weighs from 38 to 44 pounds per cubic foot. It is used for construction and carpentry work.

Canelon is a large tree of the northern provinces, with heavy, resistant, compact wood, excellent for general construction, furniture, wheels, and fuel. The bark contains considerable tannin. Weight of the wood ranges from 44 to 58 pounds per cubic foot.

Catigua (*Trichilia catigua* and *T. hieronymi*) is very abundant in the north. Both are rather small, averaging from 12 to 18 inches in

diameter and 35 to 40 feet in height. The wood is light, weighing from 35 to 40 pounds per cubic foot, fairly soft and easy to work but strong and flexible, and used for furniture, vehicles, and carpentry. The bark contains a fairly high proportion of tannin.

Cebil (*Piptadenia cebil* and *P. communis*) are abundant in the northwest, where they reach heights of 65 feet and average diameters of 30 to 40 inches. The wood is tough, durable, heavy (54 to 58 pounds per cubic foot), and is used for general construction, carpentry, and ties.

Cedro includes *Cedrela brasiliensis* of the northern provinces from Misiones to Jujuy, and *C. fissilis* of the northwestern subtropical region. Cedro is the best and the most widely used general-purpose timber in Argentina. The trees reach large size, the wood is soft, light (33 to 38 pounds per cubic foot), strong, very durable, and easy to work. It is used for lumber, boxes, furniture, interior finish, sash, and doors. The bark is used in tanning. A related species with similar wood, cedrillo (*Guarea* sp.), is abundant in northeastern Argentina, and another, cedro macho or canchorona (*Trichilia* or *Cabralea cangerana*) occurs in Misiones and Corrientes.

Ceibo (*Erythrina cristagalli*) is especially abundant in the river regions of the north, where it is much used for rafting out logs of heavier species. It is very light, soft, and perishable, weighing only about 15 pounds per cubic foot.

Cipres (*Libocedrus chilensis*) is one of the most valuable trees of the southern Andes, where it is generally used for local building construction. It reaches diameters of from 30 to 48 inches and a height of 130 feet, and occasionally forms pure stands, especially in the region of Lake Nahuel-Huapi. The wood is fairly hard, fine grained, very easy to work, weighs about 35 pounds per cubic foot, and is very durable. Another similar species, *Libocedrus tetragona*, extends into Tierra del Fuego.

Coihüe or coigüe (*Nothofagus dombeyi*) is the most abundant tree of the Argentine side of the southern Andes, where it reaches large sizes and often forms extensive pure stands. Its wood is light-colored, strong, fairly hard, weighs between 42 and 45 pounds per cubic foot, and is apt to warp and twist in seasoning. It is used in carpentry and for cooperage. Rauli and roble (*N. procera* and *N. obliqua*), which have wood of better quality and are important timber trees of Chile, are not very abundant on the Argentine side of the mountains.

Curupay (*Piptadenia* sp.) is closely related to cebil and is sometimes called cebil. It is very abundant in the northern provinces, especially in the northwest, where it forms pure stands over large areas. The wood is heavy (60 to 74 pounds per cubic foot), very strong, flexible, and durable. It is used in construction, also for barrels, ties, piling, and fuel,

and the bark is rich in tannin. It is much used in the local tanneries of Salta and Tucuman.

Chañar (*Gourliea decorticans*) is a small, crooked tree, especially abundant in the northwestern part of the country, where it is of considerable importance for local construction, fencing, and fuel.

Espinillo (*Acacia cavenia* and other acacias) is abundant in the dry forests of the west and north. The trees are rather short and are valuable for fuel and fencing rather than for lumber. The wood is very hard, heavy, durable, and difficult to work.

Guayacan negro (*Caesalpinia melanocarpa*) is a common tree of medium size, widely distributed in the northwestern provinces. Its wood is nearly black, weighs over 70 pounds per cubic foot, and is very strong and hard to work. It is used where a strong, tough, extremely resistant wood is required, and also makes excellent fuel.

Guindo or roble de la Tierra del Fuego (*Nothofagus betuloides*) is most abundant in Tierra del Fuego, where it reaches fair size. The wood is fairly light (38 pounds per cubic foot), easy to work, takes paint and varnish well, and is used for lumber and furniture. As it leaves no taste or odor, it is well adapted for food packages.

Ibiraró or palo amargo (*Pterogyne nitens*) is a fairly large tree common in the Chaco region. Its strong, hard, elastic wood weighs from 47 to 68 pounds per cubic foot and is excellent for construction, turnery, staves, oars, ties, spokes, and bentwood chairs. It is a good substitute for European oak. Much is used for fuel.

Incienso or cabriuva (*Myrocarpus frondosus* or *M. fastigiata*) occurs mostly in the northeast, where it is abundant and of fairly large size. The wood weighs from 55 to 60 pounds per cubic foot, is strong, elastic, and resembles Italian walnut, for which it is a good substitute. It is used for furniture, general construction, finish, and ties, and makes excellent spokes.

Inga (*Inga uruguensis*) is abundant in moist situations in the northeast. Its wood is soft and light, of pleasing appearance, and used for furniture and finish. The bark is used for tanning and also contains a coloring matter that can be used in making dyes and ink. Inga dulce (*Inga fagifolia*) is a smaller tree with somewhat harder wood, which greatly resembles that of European beech.

Jacaranda (*Dalbergia nigra*) is a rather small tree of the Misiones and Chaco regions. Its wood is rich dark brown or violet in color, heavy (56 to 63 pounds per cubic foot), hard, lustrous, and very flexible. It is used for fine cabinet work and veneer.

Lanza or palo amarillo (*Chuncoa triflora*) is common in the north and west. The wood is very durable, tough, and elastic, and excellent

for axles and shafts of vehicles, oars, posts, furniture, and charcoal. It weighs about 48 pounds per cubic foot.

Lapacho amarillo (*Tabebuia flavescens*) is one of the best and most widely used hardwoods of northern Argentina. It reaches fairly large size. The wood is very tough, flexible, and durable, and weighs from 69 to 78 pounds per cubic foot. It is extensively used in heavy construction, for railway cars, ties, posts, interior finish, vehicles, and furniture. Closely related but slightly inferior are other species of *Tabebuia,* known as lapachillo, lapacho blanco, and lapacho crespo.

Laurel amarillo or laurel blanco (*Ocotea* or *Nectandra* sp.) is a common, fairly large tree of the mountain regions of the north. It has moderately light (36 to 52 pounds per cubic foot), strong wood, excellent for general construction and furniture.

Laurel negro (*Nectandra porphyria*) is a common, large tree of the same region, whose wood resembles that of European walnut, and weighs from 31 to 50 pounds per cubic foot. It is flexible and very durable, even in exposed situations, and is used for construction, cabinet work, and furniture.

Lenga or loda (*Nothofagus pumilio*) forms dense stands in mixture with coigüe, in southern Patagonia and Tierra del Fuego. The wood is yellowish white, fairly strong and durable, easy to work, and light (35 to 37 pounds per cubic foot). It is sawed into lumber in Tierra del Fuego and shipped to other parts of the country for use in construction and for boxes.

Loro negro (*Cordia frondosa*) is a very abundant tree of the Misiones region, with strong, compact, heavy wood (48 to 58 pounds per cubic foot), used for construction, carts, and fuel.

Mistol (*Zizyphus mistol*) is an abundant but not large tree of the dry northwestern region. Its wood is very heavy (80 pounds per cubic foot), hard, and difficult to work, but strong and durable, and useful for construction, finish, furniture, and carriage making. The bark contains a dye, and the roots have considerable tannin.

Mora (*Morus alba*) has very hard, strong, heavy wood, much in demand for cabinet work, and its bark supplies tannin and dye, while the fruit is edible.

Nandipá (*Genipa americana*) is an excellent cabinet, furniture, and vehicle wood of the northeastern forests. It weighs about 48 pounds per cubic foot.

Nandubay, algarobilla, or calden (*Prosopis algarobilla*) forms extensive forests, or "caldenes" in central Argentina. The trees are rather short-boled but are from 2 to 3 feet in diameter. The wood is very hard, strong, and durable, and has always been extensively used for posts,

poles, and dock construction. It is very durable in water and soil, and weighs 68 to 75 pounds per cubic foot.

Nire (*Nothofagus antarctica*) is abundant in the southern Andes. The wood is light (35 pounds per cubic foot) and well suited for general carpentry, turnery, and shipping cases.

Nogal or cayuri (*Juglans australis*) is fairly common and of large size in the mountain belt from Jujuy to Santiago del Estero. Its wood is somewhat darker than North American black walnut, fairly strong, and very difficult to dry. It takes a fine polish and is used in considerable quantities for making fine furniture, carving, and panelling. It is also used for ties and beams. Its weight is about 35 pounds per cubic foot.

Palma negra, palma colorada, or caranday (*Copernicia cerifera*) forms extensive forests in the northeastern and Chaco regions. The palm is tall and slender, with very hard, durable wood, which is used for telegraph poles, posts, and beams. The leaves exude a wax similar in many respects to beeswax, and also yield a fiber which is used for making clothing and hats. The pith, similar to farina, is valuable for food. Another palm, palmera de los Andes (*Ceroxylon andicola*) occurs along the main Cordillera. It is reported to reach occasionally a diameter of 5 feet and a height of nearly 200 feet, and to yield a vegetable wax.

Palo blanco (*Calycophyllum multiflorum*) of the northern provinces reaches good size, and is valued as a substitute for boxwood, which it resembles. Another palo blanco (*Solanum* sp.) is common in Tucuman, where much of it is cut into beams.

Palo santo or lignum vitae (*Bulnesia sarmientii* or *Guaiacum officinale*) occurs in the extreme north, especially in the Chaco region.

Pehuen (*Araucaria imbricata*) occurs in the Andes of northern Patagonia, where it forms pure stands over large areas. It reaches large sizes. The wood is strong, elastic, easy to work, very resinous and durable, weighs between 34 and 40 pounds per cubic foot, and is suitable for construction lumber, as well as being an excellent wood for making paper pulp. The tree yields turpentine.

Peterebi or loro amarillo (*Cordia* sp.) occurs in Misiones and northern Corrientes. Its wood resembles light-colored walnut, is very strong and compact, weighs about 48 pounds per cubic foot, and is excellent for furniture and construction. Peterebi negro (*Sterculia* sp.), which occurs farther west, is somewhat similar.

Pino (*Araucaria brasiliana*) is abundant in eastern Misiones and reaches very large sizes. The wood is fairly strong, easy to work, soft, and light (26 to 32 pounds per cubic foot), somewhat resembling yellow pine from the United States. It is well adapted for all sorts of general

uses, and the supply is very large, though not yet developed. The tree also yields resin.

Pino blanco (*Podocarpus angustifolia*) occurs in the mountains of the northwestern provinces. It has soft, yellowish-white, fairly strong wood, which weighs from 25 to 35 pounds per cubic foot, is easy to work, and is used for carpentry, construction, furniture, and boxes. Pino de Jujuy is another *Podocarpus*, which occurs in the same region and has similar uses. It reaches 100 feet in height and the wood is pinkish instead of white. In the southern Andes there are two or three other species of *Podocarpus*, called mañiu or lleque (*P. nubigena* and *P. andina*).

Quebracho includes several different woods of different families. The most important is quebracho colorado (*Quebrachia lorentzii*) which is abundant in the Chaco region from Sante Fe northward to southern Matto Grosso. It has very hard, heavy, strong, durable wood, which weighs from 78 to 87 pounds per cubic foot and is excellent for general construction, posts, ties, and cabinet work. It is most valuable for its tannin, which constitutes about 22 per cent of the heartwood. White quebracho (*Aspidosperma quebracho blanco*) is widely distributed in the Chaco and farther west. It is not so hard or so heavy as red quebracho, but is strong and tough and makes excellent spokes and rims. It is less durable than red quebracho, hence not so well suited for ties or posts. Its widest use is for fuel, although large amounts are used in construction. Quebracho macho, quebracho rubio, and quebracho moro (*Schinopsis balansae* and other species) occur in the same general region but are less abundant. The first, at least, is rich in tannin, and its wood is similar to quebracho colorado.

Sauce colorado (*Salix humboldtiana*) is a large willow, commonly from 18 to 30 inches in diameter and 50 to 65 feet in height, sizes which it reaches in about 10 years. It is common in the Chaco and the central and northwestern provinces, in the vicinity of streams, and much has been planted. It is used for carpentry, boxes, and paper pulp.

Tala (*Celtis tala*) is a small tree, often only a shrub, but of considerable importance for fuel, fencing, and local construction in much of the central part of the country, especially in eastern Buenos Aires province, where it is practically the only common native tree, and forms extensive pure stands. Tala blanco (*Celtis sellowiana*) is a slightly larger tree of the northwestern provinces, where it is abundant.

Timbo or pacara (*Enterolobium timbouva*) is abundant in the subtropical region. It has light (20 to 30 pounds per cubic foot), soft, easily worked wood, suited for most of the uses to which pine is put, including general construction, sash, doors, ceilings, finish, and boxes.

Tipa amarilla (*Machaerium tipa* or *Tipuana speciosa*) is a large,

tall tree of the northwestern subtropical belt. The wood is something like European ash in structure and properties, weighs about 38 pounds per cubic foot, and is considered one of the best woods of the country. It is cut in considerable quantity, and used for construction, finish, furniture, vehicles, railway cars, and ties. Tipa blanca is a closely related and similar species of the same region.

Urunday or urundey (*Astronium juglandifolium*) occurs in the northeastern and Chaco regions. It is a fairly large tree, with hard, heavy (68 to 78 pounds per cubic foot), strong, dark red wood, and is much used for civil and naval construction, ties, vehicles and carpentry. It also makes excellent fuel. There are several other species of *Astronium*, called urundey crespo, urundey blanco, and urunday negro, in the same general region. Their wood is similar and is used for similar purposes.

Virapita or cañafistula (*Peltophorum vogelianum*) has light red, elastic wood, weighing from 45 to 65 pounds per cubic foot, used in construction, cabinet work, flooring, carriage making, and for ties. It grows in the Chaco.

Yerba mate (*Ilex paraguayensis* or *I. bonplandiana*) is a small tree of no importance for timber, but of very great importance for its foliage, which is used for Paraguay tea, the national beverage. In Argentina it is mostly confined to northern Misiones territory.

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BOLIVIA

Extent of Forests.—A large part of the forest region of Bolivia is practically unexplored, and data as to the area covered with forest are lacking. From such maps and descriptions as are available, however, the forest area is estimated to be approximately 200,000 square miles, or 128,000,000 acres, which is 38.9 per cent of the total area, if we accept the figure of 514,155 square miles given by the national statistical bureau. The total area of Bolivia is not definitely fixed because of boundary disputes with neighboring countries. There are about 44 acres of forest land per inhabitant.

Character and Distribution of Forests.—The western part of Bolivia, including the Departments of Oruro, Potosi, and most of La Paz and Cochabamba, is high mountain and plateau country, for the most part with a cold, arid climate and utterly destitute of forest growth. Much of the southeastern part of the country, including parts of the Departments of Santa Cruz, Chuquisaca, Tarija, and the Chaco territory, is open grassy plains, with but little tree growth except for occasional strips along streams. There are considerable areas of forest in southeastern Chaco, much of it in the territory claimed by Paraguay.

This is a continuation of the Chaco forest of northern Argentina, and is made up of similar species, including various quebrachos and other hardwoods and a great many palms, which in some places form pure stands. Farther north, in northeastern Santa Cruz, is a low hilly country covered with forest. The east slopes of the Andes in La Paz, Cochabamba, Chuquisaca, and Tarija have a warm, moist climate and are covered with a dense tropical or subtropical forest, more or less broken at the higher elevations but merging into a continuous body at the foot of the mountains. The great tropical forest of the Amazon basin covers practically all the territory of Colonias and the greater part of Beni, except for some large open, grassy plains between the Beni and Mamoré rivers and farther east. The composition of these forests is practically the same as of those of Amazonas and Matto Grosso in Brazil. Rubber trees of several species, including *Hevea* and *Castilloa elastica,* are abundant, especially in Colonias territory. They have been considerably reduced in quantity in Beni, La Paz, Cochabamba, and northern Santa Cruz, by many years of wasteful exploitation.

Ownership.—Under the law of 1905, vast areas of forest land in the rubber region were sold to individuals and corporations, and other extensive tracts were acquired by companies interested in oil resources. Before the law was suspended in 1915, more than 33,000,000 acres had been disposed of, at least 25,000,000 acres of which was forest land. As to how much was alienated previously, nothing is known. It is probable, however, that about 100,000,000 acres, or four-fifths of the total, still remains the property of the state.

Annual Cut, Annual Growth, and Losses.—No data are available as to these points. The annual cut is very small, because the forests are so located that they cannot supply the more populous industrial part of the country with timber or even with fuel wood, and the consumption within the forested region is extremely small. A conservative estimate of the cut would be about 8,550,000 cubic feet, most of it firewood. The net annual growth also probably is negligible, because of the fact that the forests are all in virgin condition. The climate is so moist throughout most of the timber region that forest fires cannot occur. Indeed it is stated that attempts to clear land by felling the trees and burning the slash have not been successful.

Exports and Imports.—Exports of wood and timber from Bolivia are of very little importance, ranging during recent years between $5,000 and $12,000 in value, and between 700 and 1,400 tons, or approximately 30,000 to 60,000 cubic feet, in quantity.

Imports, on the other hand, are considerable, because the forests, although they contain more than enough material to fill all the domestic

requirements for wood, are not connected with the consuming regions by facilities for transporting forest products. Total imports for 1914 and 1917 are shown in Table 316.

TABLE 316.—IMPORTS OF TIMBER, BOLIVIA

	1914	1917	Principal source
	metric tons	*metric tons*	
Railroad ties	5,773	6,813	More than 90 per cent from Chile.
Lumber, rough and dressed	17,852	9,724	65 to 85 per cent from United States.
Cabinet woods	6	42	Nearly all from Chile.
Total	23,631	16,579	

In 1918 total imports of lumber were 14,078 tons, of which 29 tons were cabinet woods and 564 tons dressed lumber. Most lumber is imported in the form of rough planks and beams, because such material is free of duty. In 1918 the United States sent 10,687 tons of railroad ties to Bolivia; data regarding imports of ties from Chile are not available. In all, the average normal imports of wood may be estimated at about 23,000 metric tons, or 1,500,000 cubic feet, consisting mostly of Douglas fir, redwood, and Chilean roble.

In 1913 manufactures of wood, including furniture, were imported to the value of $270,000, about half coming from Germany, one-fifth from the United States, and the rest from Great Britain, France, Chile, and Belgium. Paper to the value of $180,000 was imported in the same year, half from Germany and the rest from Italy, United States, Belgium, France, Chile, and Great Britain.

Imports for La Paz and vicinity are brought in by way of Arica, Chile, and Mollendo, Peru, while those for Oruro and the southern part of the country go through Antofagasta, Chile.

Domestic Consumption.—Bolivia uses very little wood. Except for flooring, lath, and framework, little lumber is used in building construction in the more thickly settled parts of the country. The small towns in the Amazon basin are built of wood, but do not consume very much in the aggregate. The chief users of lumber are the mining companies, and they use almost all of the imported lumber. Railroads use some lumber, and also use wooden ties on about three-fourths of the 1,400 miles of line in the country. All these ties are imported, except those used on the very few miles of line east of the mountains. There are almost no wood-using industries. Not even for fuel are there

supplies of wood available to the consuming regions, hence the consumption of firewood is very small, except in the country east of the mountains. The total normal consumption for all purposes is probably less than 2,000,000 cubic feet per annum, or about 1 cubic foot per capita, in the plateau region. To the north and east the per capita consumption is greater, probably at least 8 cubic feet, making the average for the entire country about 3.5 cubic feet, and the total consumption about 10,000,000 cubic feet.

The Lumber and Wood-Using Industries.—The lumber industry is still in a very primitive state, because of the lack of railroads between the forests and the consuming centers. There are plenty of navigable streams in the north and east, affluents of the Amazon and Paraguay, but they flow away from the consuming centers. What lumbering is done is mostly handwork, with axes and cross-cut saws. There are very few wood-using industries, and what there are are small. Most of the box shooks used in Bolivia are imported from the United States and Chile. One match factory, making both wax and wooden matches, has a monopoly of that industry. Some furniture and other products are made in small shops.

Forestry and Forest Laws.—Bolivia has not yet reached the point of reserving and administering her forests for timber production. In 1915, however, the law of 1905 allowing sales of large tracts of land at nominal prices was suspended, and it is probable that some tracts already claimed by private owners may revert to the state, because of failure to comply with the terms of the concessions.

The National Congress passed a law in 1918 providing for a nursery to produce trees with which to reforest the Bolivian highlands, and also offering premiums to land owners who have more than 1,000 trees living, at least 2 meters high.

Minor Forest Products.—*Rubber.*—Next to tin, rubber is the most important item of Bolivia's export trade. The extraction of rubber from the forests of northern Bolivia began in 1864, but did not really become an important industry until about 1882. Rubber is produced in the Departments of Beni, Cochabamba, La Paz, and Santa Cruz, which have been mostly worked out, and in the territory of Colonias, which now furnishes most of the output. Several species yield rubber, including *Hevea* (Para rubber), *Castilloa elastica* (caucho), and the less common *Manihot glaziovii* (ceara rubber). Exports of rubber have increased from 294 metric tons, worth $490,000, in 1890, to 5,347 metric tons, worth $4,160,000, in 1919. The maximum amount exported was 5,843 tons in 1917, and the maximum value was $10,785,000 in 1910. Average annual exports by periods have been as follows:

	Metric tons
1890–1895	475
1896–1901	2,512
1902–1907	1,705
1908–1913	3,608
1914–1919	4,989

In 1911, rubber was 22.89 per cent of the total exports in value, and in 1918 it was only 6.04 per cent, because of the decline in values of rubber together with increased exportation of minerals.

In 1912 and in 1918 rubber exports were distributed as shown in Table 317.

TABLE 317.—DISTRIBUTION OF RUBBER EXPORTS, BOLIVIA

Country	1912	1918	Country	1912	1918
	per cent	*per cent*		*per cent*	*per cent*
United States	2.3	84.22	Chile	.....	0.01
France	9.5	7.15	Germany	30.2	.....
Uruguay	.....	5.06	Belgium	12.5	.....
Great Britain	45.5	3.53			
Spain	.....	0.03	Total	100.0	100.00

Practically all of the rubber is exported by way of the Amazon.

Cinchona Bark.—Cinchona bark, quina, or quinine bark, comes from the headwaters of the Beni River. During the period 1913-1918 the annual exports averaged 276,000 pounds, ranging between 65,550 pounds in 1914 and 485,950 pounds in 1917. Most of this product is exported via Arica and Mollendo, and goes very largely to the United States, which took 63.86 per cent in 1918, while Great Britain took 15.81 per cent and Spain 9.48 per cent.

The Probable Future.—Plans have been made to construct railroads from the western plateau over into the eastern part of the country for the purpose of opening that region to development. When completed, these roads will make it possible for the eastern forests to supply almost all of the domestic requirements for fuel wood, ties, and construction material. Other roads will no doubt be constructed later, joining eastern Bolivia with the Atlantic coast of Brazil, so that it will be possible to export the more valuable woods either to the east or to the west. Considering the vast areas of similar forest in Brazil and northern South America, which are much nearer to the world markets, it is hardly likely that Bolivia will ever contribute very much timber to the general market.

Trees of Bolivia.—The woods of the Amazon forests are substantially the same as those described under Brazil. Those of the mountain

and savanna forests and of the eastern hill country include the following:

TABLE 318.—PRINCIPAL TREES, BOLIVIA

Ajunado (*Andira* sp.)—savannas. Good for spokes, building, and furniture.
Algarobilla (*Caesalpinia melanocarpa*)—Chaco region. Good for construction, ties, and handles. Called guayacan in Argentina and Paraguay
Algarrobo cupesi (*Prosopis juliflora*)—savannas Good for ties and handles.
Amarillo (*Chlorophora* or *Maclura tinctoria*)—eastern savannas. A dyewood (fustic) and good for cabinet work.
Arandaibuso (*Rhus* sp.)—western Chaco. An excellent construction timber, and good for spokes, tools, and machinery.
Balsamaria (*Calophyllum inophyllum*)—Amazon. Used for boats and construction, and suitable for panels and cigar boxes.
Chonta (*Guilelma insignis*)—Amazon and mountain forest. A palm used for building, fencing, canes, and bows. Good for furniture.
Chucupe—deciduous mountain forest. Similar to hornbeam (*Carpinus*). Used for construction, and suitable for spindles.
Cuchi (*Astronium urundeuva*)—savannas. Very durable, and used for building, especially in damp places. Good for paving and mallets. Called aroeira do campo in Brazil, also known as eisenholz, or ironwood.
Curupay (*Piptadenia macrocarpa*)—eastern hills and plains. Used for construction, fairly good for furniture, and bark yields tannin. Called cebil in Argentina.
Cuta—mountain valleys. Used for construction and furniture.
Guayacan (*Bulnesia sarmienti*)—dry eastern region. Used to some extent for construction, and good for furniture, machine parts, and tool handles. Used for kegs and water buckets, to keep water fresh. Known as palo santo in Paraguay.
Guino-guino (*Berberis bumeliifolia*)—mountains. A cabinet wood, used to some extent for dye
Jacaranda (*Machaerium* sp.?)—eastern districts. An excellent wood, used for furniture and finish, and a source of dye.
Jichituriqui (*Aspidosperma* sp.)—savannas.
Lapacho (see tajibo).
Laurel (*Oreodaphne* sp.)—savannas. Used for furniture, and some construction.
Mara, or mahogany (*Swietenia* sp.)—Cordillera forests. Used for construction, furniture, and finish.
Momoqui (*Caesalpinia peltophoroides*)—dry savannas. Used for turned ware, and possibly for construction.
Morado (*Peltogyne confertiflora*)—mountains and eastern hills. Used for construction, and a good furniture and cabinet wood.
Negrillo (*Ocotea* sp.)—mountains. Used for furniture and construction.
Nogal (*Cedrela* sp.? and *Juglans* sp.)—deciduous mountain forest. Used for building, furniture, panels, and general purposes.
Palo blanco.
Quebracho blanco and others common to the Chaco region of Argentina and Paraguay.
Quina-quina (*Myroxylon peruiferum*)—mountains. Used for spokes, axles, and construction, and a good furniture wood.
Sama (*Cupania cinerea*)—savannas. A building wood, and good for furniture.
Soto blanco (*Schinopsis marginata*)—dry mountain forest. Used for building, and probably good for handles and inlaying.
Soto negro (*Schinopsis* sp.)—dry western Chaco. Good for building, but not for furniture.

TABLE 318.—PRINCIPAL TREES, BOLIVIA—*Continued*

Tajibo (*Tecoma* spp.)—savannas and dry forests. Especially durable in contact with the soil, and very good fuel. Also good for finish, tool handles, and machinery. One species is an excellent furniture wood.

Tara (*Coulteria tinctoria*)—eastern savannas. Some used for dyewood, more for staves. Good for vehicles.

Toborochi (*Ceiba erianthus* ?)—dry eastern region. Very light (specific gravity 0.118). Used for rafts and floats.

Urunday (*Astronium* spp.). Construction, vehicles, ties.

Viñatico (*Enterolobium* sp.)—eastern hills. Good for vehicles, probably not for furniture.

Yabe (*Mouriria parvifolia*)—damp northeastern region. Used for construction and tools.

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BRAZIL

Extent of Forests.—Of the total land area of Brazil, which is approximately 3,300,000 square miles, 1,920,000 square miles (1,235,000,000 acres) or 58 per cent, was originally forest land, distributed among the individual states as shown in Table 319.

During the more than 400 years that have elapsed since the first white settlement the area of forest has been much reduced, especially in the states bordering on the Atlantic, so that the present area covered with merchantable timber is estimated at about 40 per cent of the land area, or approximately 850 million acres. This is 28 acres per inhabitant. Large areas have been cleared to make room for agriculture and a great deal of forest has been cut over for the timber, especially in the more densely populated regions and along the railroads, where the consumption of wood fuel is enormous. Most of the domestic requirements for wood have been supplied by the eastern forests, while considerable quantities of the more valuable kinds have been exported since the colonial period.

As a result, the forests of the eastern and northeastern states have been greatly reduced. In Bahia, Espirito Santo, and Rio de Janeiro from one-third to one-half of the original forest has been destroyed. In Sao Paulo at least half of the original area has been devoted to raising coffee and other crops, and the forests of Rio Grande do Sul have been reduced by half. While some clearing has been done in Parana and Santa Catharina, their forests have only recently begun to be exploited on a large scale, and most of the original timberland still remains. Much

of Minas Geraes also has been cleared. The great interior forests of Amazonas, Acre, Matto Grosso, and Para, on the other hand, have scarcely been touched, except to cull out a few select trees close to the larger rivers or to harvest the wild rubber, and except for the small openings made by the Indian population, which are negligible in the aggregate. Considering the relatively small population, and the low requirement for wood as compared with that of peoples in colder climates, it seems hardly likely that nearly 400 million acres of forest can have been entirely cleared off. The figure of 850 million acres given above, therefore, must be very conservative, and it is probable that the total forest area, including timber not now merchantable because of small size or culled-over condition, is at least one billion acres, or about 33 acres per capita.

Character of the Forests.—With an area greater than continental United States, exclusive of Alaska, Brazil lies for the most part in the tropics and has a much less varied climate than the United States. The

TABLE 319.—ORIGINAL DISTRIBUTION OF FORESTS, BRAZIL

State	Total area	Forest area	Ratio of forest to total area
	sq. mi.	*acres*	*per cent*
Amazonas	707,400	415,806,000	92
Para	470,900	227,723,000	76
Maranhao	131,350	35,906,000	43
Piauhy	89,200	15,417,000	27
Ceara	60,850	16,784,000	43
Rio Grande do Norte	21,700	3,536,000	25
Parahyba	20,150	4,714,000	37
Pernambuco	36,750	8,033,000	34
Alagoas	11,750	2,106,000	28
Sergipe	8,400	2,216,000	41
Bahia	226,750	53,213,000	37
Espirito Santo	15,100	7,396,000	77
Rio de Janeiro	17,100	8,887,000	81
Sao Paulo	96,500	39,952,000	65
Parana	69,600	39,606,000	83
Santa Catharina	42,550	21,437,000	79
Rio Grande do Sul	109,350	22,016,000	31
Minas Geraes	234,650	68,819,000	46
Goyaz	247,250	44,302,000	28
Matto Grosso	599,900	149,879,000	39
Acre (territory)	74,100	47,424,000	100
Total	3,291,300	1,235,172,000	58.6

character of forest is far from uniform, however, because of differences in topography and rainfall.

The great Amazon plain, from the Atlantic to the slopes of the Andes, west of the Brazilian boundary, is a region of comparatively heavy precipitation. Near the coast there are distinct wet and dry seasons, while farther inland the precipitation is more or less evenly distributed throughout the year. Within this region the type of forest is determined chiefly by its elevation above water. The forest is in an almost unbroken body north of the Amazon, except for some large open plains or "campos" in the northeastern highlands, and extends from 350 to 500 miles south of the river and even farther in narrow belts along the rivers. There are some 2,500 arborescent species here, out of possibly 10,000 woody plants, including shrubs and vines.

The Atlantic coastal range, the Serra do Mar, intercepts the heaviest precipitation that falls in Brazil, and therefore its seaward slope is covered with a most luxuriant forest growth. This belt extends through 20 degrees of latitude, beginning at about the latitude of Pernambuco, and varies in width from 30 to 40 miles at the north end to 200 miles in Espirito Santo, tapering off again south of Rio de Janeiro, and farther south extends in a 200-mile belt in Santa Catharina and Parana to the basin of the Parana River. It extends somewhat beyond the tropics to nearly 30 degrees south latitude. The best forests are in the States of Minas Geraes, Bahia, and Espirito Santo.

The forests of the Parana, Paraguay, and Uruguay river basins extend over most of the States of Parana, Santa Catharina, and parts of Sao Paulo and Rio Grande do Sul. Much of this is a more or less elevated plateau region, which is not quite as tropical in character as the other parts of Brazil, and is occupied by a distinct type of forest. This is the region of the coniferous *Araucaria* forests—the "pinheiros."

The interior region, west of the coast ranges and south of the Amazon basin, is largely open country. Several types of forest occur there, however, including tropical "rain" forest, open dry forest or "caatingas," and swamp forest or "pantanales." The interior "rain" forests are in the States of Minas Geraes, Goyaz, Matto Grosso, Sao Paulo, Parana, Santa Catharina, and Rio Grande do Sul, on the mountains and high slopes of the interior dry region, which intercept the rain and have dense stands of timber, often covering large areas. Various sub-types of forest here grade off into the scrubby growth of the plains. Similar in composition are the "gallery" forests along the streams in the dry "campos" region of the interior.

The "caatingas" are open forests of more or less stunted trees, which lose their foliage during the dry season. This type is characteristic of

much of the northeastern part of the country, between the northern end of the coast range and the southern edge of the Amazon forest.

Some parts of the coasts, especially in the north, are lined with belts of mangrove forests, usually only a few miles wide but in places covering large areas. These forests serve to hold the shores in place against the erosive action of the waves and ocean currents, and are of greater importance for this purpose than for commercial exploitation.

The Amazon Forest.—From the mouth of the Amazon to the foot of the Andes, and from the upper branches of the Madeira to the forks of the Orinoco, the country is all forested, except for occasional breaks or "campos." This is probably the most extensive solid body of forest in the world. In the state of Amazonas there are few breaks except the campos of the upper Branco, about 13,500 square miles in extent, and another area between the Madeira and Purus rivers between latitudes 7 and 8 degrees south. While there is more open country in Para, especially north of the river, such openings cover less than one-fourth of the total area. The forests of the Amazon may be classified in three types: the coastal forests; the river forests, subject to periodic inundation; and the forest of "terra firme," above the flood level.

The coastal forests, or "mangales," are composed of comparatively few species, and resemble the forests along the coasts of other parts of tropical America, as well as Africa and the East Indies. The important species are various mangroves, including mangue vermelho (*Rhizophora mangle*), ciriuba (*Avicennia nitida* or *A. tomentosa*), mangue branco or tinteira (*Laguncularia racemosa*), *Conocarpus erectus,* and *Bucida buceras.* Of these, the first two are of some importance for industrial use.

The inundated forests, or "varzeas," occur along the Amazon and its main tributaries from Belem to the foot of the Andes. These are more varied in composition than the coastal type, and change considerably with differences in drainage and soil, as well as with geographical location. Along the lower Amazon, important species include the following:

Bombax monguba—munguba, mongubeira
Triplaris surinamensis—tachy
Cordia tetrandra—parapara
Spondias lutea—tapereba
Virola surinamensis and *V. sebifera*—ucuuba
Carapa guianensis—andiroba, Amazon mahogany
Sapium lanceolatum—murupita
Genipa americana—genipapo, genipapeiro
Platymiscium paraense—macacauba da varzea
Couropita surinamensis—castanha de macaco
Olmedia calophylla or *O. caloneura*—muiratinga
Guazuma ulmifolia—mutamba
Calycophyllum spruceanum—pao mulato

Nectandra amazonum—louro da varzea
Pterocarpus ancylocalyx—tachy de flor amarella
Urostigma pertusum, *Pharmacosycea* (*Ficus* sp.)—cuaxinguba
Ceiba pentandra—sumauma, sumaumeira

Farther up the river are large areas of palm forest characterized by the jauary palm (*Astrocaryum jauary*), and on a little higher land, urucury (*Attalea excelsa*), pachiuba (*Iriatea exorrhiza*), assahy (*Euterpe precatoria*), and other palms, and a multitude of other species, among which may be mentioned the following:

Ceiba sumauma—sumauma, sumaumeira
Olmedia calophylla or *O. caloneura*—muiratinga
Cedrela fissilis and *C. huberi*—cedro
Dipteryx (or *Coumarouma*) *odorata*—cumaru
Dipteryx (or *Taralea*) *oppositifolia*—cumaru rana
Hymenaea sp.—jutahy
Copaifera langsdorfii or *C. martii*—Copahyba, ("purple heart")
Couroupita subsessilis—castanha de macaco
Couratari tauary—tauary
Hura crepitans—assacu
Erythrina glauca—assacu rana
Parkia multijuga or *P. pectinata*—parica
Andira spp.—angelim
Apuleia molaris—

Although many of the species of the lower river also occur here, some do not. Rubber tree (*Hevea brasiliensis*) is at its best through this region. The trees on these higher lands are 130 feet tall, or more, while on the lower lands they seldom exceed 100 feet. Farther down the river heights greater than 60 feet are not common, and in some stands do not exceed 30 feet. These swamp forests are generally irregular in age and rather open. The dominant stand is usually composed of comparatively few species, so that four or five will furnish possibly three-fourths of the total cut, which will amount to some 8,000 board feet per acre. Dominant trees reach diameters of 2 or 3 feet, and some species reach this size in from 10 to 15 years, so rapid is their growth. Trees larger than this are not common, though occasional individuals are considerably larger. *Ceiba, Bombax, Hevea,* and *Ficus* are the largest trees in these forests. Soft woods predominate, many of them of light color, and therefore these forests promise to be of considerable commercial importance in the future. Boxes for shipping crude rubber are made from two local woods, mandioqueira and curuba.

The forests of "terra firme" are very rich in species, many of which are already established in the domestic markets. A few of the better known trees are:

Vouacapoua americana—acapu, Amazon-wood
Euxylophora paraensis—pao amarello, satinwood
Zollernia paraensis—pao santo, Amazon lignum vitae
Mimusops spp.—massaranduba, maparajuba, cow-wood, balata
Chytroma jarana—jarana, Amazon oak
Eschweilera mata-mata—mata mata
Bertholletia excelsa—castanha, Brazil nut
Castilloa ulei—caucho, rubber
Silvia itauba—itauba verdadeira, stonewood
Aniba canalilla—casca preciosa
Hymenaea spp.—jutahy, locust
Parkia spp.—parica
Proteum spp.—breu, almecequeira
Caryocar spp.—piquia, piquia-rana
Sterculia sp.
Jacaranda spp.—caroba, para-para, paraparay-guassu
Simaruba amara and *S. officinalis*—marupa, paradise wood, bitterwood
Cedrela spp.—cedro
Brosimum guianense and *B. discolor*—muirapinima, muirapiranga, letterwood
Aniba parviflora—pao de rosa
Nectandra spp., *Ocotea* spp., *Cordia* spp.—louro
Peltogyne spp.—pao roxo, guarabu, pao violeta
Dalbergia spruceana—jacaranda, rosewood
Humiria floribunda—umiry, bastard bullet wood
Carapa guianensis—andiroba, crabwood
Platonia insignis—bacury
Physocalymma scaberrimum—pao de rosa, Sebastiao de arruda, cejo machado, tulipwood
Lecythis spp.—sapucaya, monkeypot
Lucuma spp.—abieiro, abiu
Cordia goeldiana—frei jorge, freijo, Amazon teak
Tecoma spp.—pao d'arco, bow-wood
Symphonia globulifera—anany
Dicypellium caryophyllatum—cravo
Goupia spp.—cupiuba, cupuiba
Vochysia paraensis—guaruba
Terminalia acuminata—guarajuba
Macrolobium spp.—ipe
Calophyllum brasiliensis—jacareuba
Astronium or *Centrolobium* sp.—muiracoatiara
Pterocarpus suberosus—mututy
Apeiba tibourbou—pao de jangada
Bowdichia spp.—sucupira or sapupira
Bagassa guianensis—tatajuba
Maclura spp.—tatajyba
Poraqueiba spp. and *Couepia* sp.—umary

The forests of Amazonas are even richer in species than those of Para. The general height of these stands averages about 100 feet, with individual trees frequently as much as 160 feet tall. The average rate of

growth is considerably slower than in the swamps, although some species, such as *Parkia, Hymenaea, Caryocar, Jacaranda, Simaruba,* and *Cedrela,* grow rapidly. The largest trees are *Parkia, Proteum, Caryocar, Bertholletia, Sterculia* and *Hymenaea.*

The forests of the Atlantic Coastal Region.—This forest begins at Cape St. Roque (5° 30′ south latitude), but is not sufficiently extensive to be of more than local importance north of 10° 30′, about the latitude of Pernambuco. From here it extends southward to nearly 30° south latitude, in a belt of varying width, averaging 125 miles, and more than 200 miles wide where the forests follow the larger valleys back into the mountains. Along the coasts are belts, in most places narrow, of scrubby vegetation, or, in some localities, of mangrove forest. Although the mangrove belts contain much material valuable for tanning and also for fuel as well as some construction timber, they must, for the most part, be kept covered with forest growth in order to protect the shores against erosion by the waves and ocean currents.

Behind the coastal belt are the foothills and slopes of the coastal ranges, which were originally almost entirely clothed with dense forests. It is in this region that most of the clearing has been done, for the greater part of Brazil's population is located in the eastern coastal belt and the plateau behind it, and outside of this belt there are few railroads. Vast quantities of wood have been cut for fuel for the railroads and industrial and domestic use, and for railroad ties and local construction; but much greater quantities have been piled up and burned, just as was done in the Ohio valley of the United States, in order to clear the land for agricultural use. In the region of Rio Dulce and north there is a stand of at least 200 billion feet of hardwood. The main body of the Atlantic slope forest is in northern Espirito Santo, southern Bahia, and the adjacent portion of Minas Geraes. It begins about 20 or 25 miles inland from the coast.

The forest is denser and the trees larger than in the Amazon region, and the variety is even greater. There are 50 or more species of woods which are already of considerable commercial importance, including both cabinet woods and woods used for general construction, and many others will eventually come into more or less general use. Woods are mainly soft or of medium hardness, and can replace pine for construction, oak for furniture and finish, hickory for wheels and handles, and ash for agricultural implements. Average stands will cut from 10,000 to 20,000 board feet per acre, including all species, while the better stands yield from 1,400 cubic feet of squared trunk-wood per acre at the higher elevations to 7,500 cubic feet on the bottom lands. Diameters run from 2 to 3 feet, clear lengths about 50 feet, and total heights over 100 feet. In typical stands in Bahia, averaging about 10,000 board feet per acre,

ten species will furnish most of the cut, of which 42 per cent (by volume) will be soft woods, similar to yellow poplar; 30 per cent of medium hardness, similar to maple, oak, and ash; and 28 per cent harder than white oak. In the same region, in stands having from 8,000 to 10,000 board feet of hardwoods, it is said that about 1 per cent (by volume) has properties and uses similar to rosewood; 5 per cent is similar to jacaranda cabiuna; 10 per cent resembles mahogany; 15 per cent oak; 20 per cent hickory; 40 per cent birch, beech, maple, elm, and ash; and 9 per cent Spanish cedar. About 30 per cent of the volume of the stands in one locality is composed of five kinds of woods—jequitiba, sapucaya, gonçalo alves, vinhatico, and peroba; and from 80 to 90 per cent of the lumber cut now is peroba. Among the more important species are the following:

Cedrela spp.—cedro
Cabralea cangerana—cangerana
Nectandra spp.—canella (about 25 species)
Hymenaea courbaril—jatoba, jatahy, or jutahy
Piptadenia spp.—angico
Cordia spp.—louro
Lecythis spp.—sapucaya
Andira spp.—angelim
Copaifera spp.—copahyba, pao de oleo, oleo branco
Bowdichia spp.—sucupira, sibipira, secupira
Machaerium spp.—jacaranda, palissandre (many species)
Mimusops spp.—massaranduba
Aspidosperma spp.—peroba (several kinds)
Couratari spp.—jequitiba
Lucuma procera—massaranduba branca
Genipa americana—genipapo
Physocalymma scaberrimum—Sebastiao de arruda, pao rosa
Platonia insignis—bacury
Tecoma spp.—ipe, pao d'arco
Rheedia spp.—bacopary
Caryocar sp.—pequi
Aspidosperma eburneum and *A. gomesianum*—pao marfim, pequia marfim, pao setim
Peltogyne spp.—roxinho, pao roxo, amarante, guarabu
Apeiba tibourbou—pao jangada
Astronium graveolens and *A. fraxinifolium*—gonçalo alves
Psidium guayava—goiabeira
Myrocarpus fastigiatus and *M. frondosus*—cabreuva
Schinus spp.—aroeira
Enterolobium spp., *Echinospermum* spp., *Plathymenia* spp., and *Pithecolobium* sp.—vinhatico
Myrocarpus or *Myrospermum* spp.—balsamo, oleo vermelho
Myristica spp.—bicuhyba
Centrolobium spp.—arariba
Apuleia praecox—garapa amarella, grapiapunha
Lucuma laurifolia—guapeba
Apuleia ferrea—quiripyranga, pao ferro

Simaruba sp. and *Tabebuia* sp.—caixeta
Caesalpinia echinata and *C. brasiliensis*—pao Brasil, pao Pernambuco, ibirapitanga, Lima wood
Rustia formosa—sobrasil
Raputia spp.—arapoça
Enterolobium timbouva—timbouva
Tabebuia spp.—roble blanco, white cedar, pao d'arco
Melanoxylon brauna—brauna parda or preta
Roupala brasiliensis—cutucanhen
Dalbergia nigra—cabiuna, rosewood
Aspidosperma subincanum—pao pereira
Astronium spp.—aderno
Pterocarpus spp.—pao sangre
Zollernia ilicifolia and *Swartzia crocea*—mocitahyba
Chrysophyllum glyciphloeum—buranhen

The Parana Pine Forest.—Extending westward from the summit of the coast range, in the States of Sao Paulo, Parana, Santa Catharina, from 29° 30′ south latitude in Rio Grande do Sul to 18° south in Minas Geraes, is a mountain and plateau region, considerably cooler than that along the coast and with a drier climate. This is an exceedingly important forest region, characterized by the predominance of Parana pine, or pinho (*Araucaria brasiliana*). This is the only coniferous tree found in Brazil, except for two comparatively unimportant species of *Podocarpus*, which occur in the mountains of Sao Paulo and Minas Geraes.

Covering a gross area of 300,000 square miles, the area of commercially valuable pine forest (mostly between 22° and 27° latitude) is estimated at about 100 million acres. In many places the stands are fairly open, without underbrush, and are composed almost entirely of pine; in other places there are more hardwoods, with a dense understory of small trees and brush, especially toward the south, where maté (*Ilex paraguayensis*) is abundant. The stands are usually four-storied, with *Araucaria* only in the upper story, 80 to 120 feet tall; a second story, 60 to 80 feet tall, of hardwoods, about 50 per cent being various species of the laurel family (canellas and embuia), and the rest *Cedrela* and various leguminous species; a third story with a large number of species, predominantly *Lauraceae* and *Myrtaceae*, 30 to 60 feet tall; and an understory of tree ferns, bamboos, and maté (yerba maté in Spanish, herva matte in Portuguese), mostly from 10 to 30 feet tall. The pines are straight and fairly free from branches in the lower part of the trunk, often having 50 feet clear length. Diameters of mature trees occasionally reach from 5 to 8 feet, and heights of 165 feet are common. Average mature trees are about 3 feet in diameter, with 4 to 5 16-foot logs. The hardwood species, which include many of those found in the coastal region, comprise an average of about 10 per cent of the total stand and are more apt to be crooked than the pine. Embuia, various canellas

(*Nectandra* spp.), and cedar (*Cedrela*) are of the greatest commercial value among the hardwoods. Angico (*Piptadenia* spp.), ipe (*Tecoma* spp.), araça (*Psidium* spp.), camboatan (*Cupania* or *Machaerium* sp.), guabiroba (*Campomanesia* spp.), guayuvira (*Patagonula americana*), and guaraiuva (*Terminalia acuminata*) also occur. There are several species of comparatively soft wood, including mandiogueorba, umbanda, and cachete, which may be used for paper pulp, although they produce a rather inferior grade, which must be mixed with better material to make good paper. In Parana, stands cutting from 14,000 to 25,000 cubic feet per acre (for small areas) have been reported, but the general average for the commercial stands, leaving out blanks, is from 7,000 to 12,000 board feet per acre, and stands running 25,000 board feet are not rare. Logs run about 3 per 1,000 board feet.

The total stand of Parana pine has been estimated at all the way from 200 to 650 billion board feet, and judging from the available data as to area and average stand it will fall somewhere between the two estimates. At any rate the supply is enormous in comparison with the demands that are made on it now or that are likely for many years. It has been estimated that 50 billion feet is now within reach of existing transportation facilities.

Forests of the Interior.—The great interior plateau region, west of the coast ranges, has a comparatively dry climate, and is predominantly a grazing country, with wide expanses of "campos" covered with grass or low shrubs. The higher mountains, however, intercept the rains and their eastern slopes are clothed with dense forests. There are considerable areas of this character in Minas Geraes, Goyaz, Matto Grosso, Sao Paulo, Parana, Santa Catharina, and Rio Grande do Sul. In the forests, which are similar to those of the Atlantic slope, the most abundant construction woods are peroba, jequitiba, cabreuva, jacaranda, ipe, and canella. Other common species include: angico, jatoba, copahyba, cañafistula, aroeria, arariba, bicuiba, cedro, cangerana, massaranduba, tamboril, amendoim, orindiuva, gibatan, saguaragy (*Colubrina rufa*), peito de pomba (*Guarea* spp.), guajissara, grumichaba (*Eugenia* spp.), guamixim, cambuhy, catigua (*Trichilia catigua*) guarantan (*Esenbeckia* sp.), carvalho, capixingui (*Croton floribundus*), caixeta (*Tabebuia* sp.), uvatinga, and vassatonga. Various sub-types, with the stands becoming more open and the trees shorter, grade off into the campos or open plains region. All through this region the streams are bordered with ciliar or "gallery" forests, varying in width from a few rods to several miles. Because of the vast extent of the region, they vary widely in composition, but in a general way resemble those just described. Around springs there are also occasional groups, or forest "islands," generally composed of buritys palms or of that species mixed with pindahyba.

In the drier regions, especially in the northeastern part of the country, are large areas of "caatingas"—open stands of rather short-boled, frequently thorny trees, which shed their leaves in the dry season. Various species of *Leguminosae* predominate, and some furnish valuable construction and cabinet woods. The trees are seldom more than 50 feet tall and often less than 25 feet, while merchantable lengths run from 10 to 20 feet. Diameters of 1 to 2 feet are common. Among the more important species are: jacaranda, angelim, sucupira, pao ferro, jatoba (jutahy), angico (jacare), sobreiro (*Pithecolobium* sp.), vinhatico, ximbo (*Enterolobium* sp.), imburana (*Bursera leptophloea*), pereiro (*Aspidosperma* spp.), gonçalo alves, aroeira, ipe, catinga da porco (*Caesalpinia porcina*). There are all gradations between these forests and the thorny scrub and low brush with scattered, orchard-like trees which occupies extensive areas of the central Brazilian plateau—the "campos cerrados."

A very important tree in the northeastern states (Parahyba, Ceara, Rio Grande do Norte, Piauhy, and adjacent parts of other States) is the carnauba palm (*Copernicia cerifera*). This tree furnishes building lumber, and is even more valuable for the vegetable wax which it produces.

About 45,000 square miles in Matto Grosso and some areas in other states are occupied by the "pantanales," swampy areas inundated during several months of each year. Some of the trees of the campos and caatingas are found here, and palms are especially numerous, although as a whole it is a pasture region. In the forests of the upper Parana River, in Matto Grosso, the following are the most abundant species: coronillo, or quebracho macho (*Schinopsis balansae* ?), *Astronium juglandifolium, Piptadenia cebil, Tabebuia flavescens, Pterogyne nitens,* white quebracho (*Aspidosperma quebracho blanco*), rosewood (*Machaerium* or *Dalbergia* sp.), *Chorisia insignis, Calycophyllum multiflorum,* paratodo (in the campos), and *Cedrela* sp. (back from the river). Others which are cut to some extent include *Acacia farnesiana, Caesalpinia melanocarpa, Patagonula americana, Bumelia obtusifolia, Bulnesia sarmientii, Quebrachia lorentzii, Enterolobium timbouva, Pisonia zapallo, Spondias lutea, Maytenus gonocladus, Trithrinax braziliensis, Copernicia cerifera,* curuñay, quirandy, morerybo, and trebol.

Character of Ownership.—Data regarding ownership of the Brazilian forests are very limited. The federal government turned its rights over to the individual States, and now owns only the forests of the territory of Acre, which was acquired from Bolivia in 1903. The states own large areas—probably the bulk of the Amazon and coastal forests, but not so much of the Atlantic slope and pine forests, the more accessible portions of which are largely in private ownership. Individual holdings are mostly large.

Annual Growth.—Figures on annual growth in an almost entirely undeveloped forest region such as Brazil would be practically meaningless. Growth of many of the species is extremely rapid, in comparison with the rate of growth in temperate climates. As most of the forest is in virgin condition, however, it is probable that the net growth, after allowing for natural losses, does not exceed, if it equals, the annual cut. Abandoned clearing grow up rapidly and resume the appearance of virgin forest within 20 or 30 years, but the second-growth stands are made up for the most part of rather inferior softwood species. The variety is not as great as in virgin forest.

According to one writer, the average growth in 7 or 8 years in the moist tropical forest is as great as 25 years' growth in European coniferous forests. The fastest-growing trees are the softwoods of the periodically inundated Amazon forests, such as ceiba and imbauba. It is stated that most trees of the high "varzeas" reach 65 feet tall in 10 years. In the "terra firme" forests, growth in general is less rapid, but some species, such as parica, jutahy, piquia, caroba, marupa, and cedro grow very fast. Cedro reaches sawlog size in 10 to 12 years. Many of the more valuable hardwoods grow comparatively slowly. Parana pine is reported to grow very rapidly and to attain good sawlog size in 20 years.

Annual Cut.—Statistical data regarding the amount of timber cut annually are extremely fragmentary. Little lumber is cut except in the eastern coastal region, where most of the population, industries, and railroads are concentrated. During the war, development of the Parana pine forests was undertaken on a fairly large scale, in comparison with previous operations, and now more lumber is cut in that region than in any other. The production in the Amazon region is still small, though it is increasing. The annual lumber cut that reaches the general market is approximately 55 million board feet of hardwoods and 150 million feet of Parana pine. Considerable additional amounts may be used locally in small towns and on the large plantations and ranches. Besides lumber, from 8 to 12 million ties are used annually, equivalent to from 200 to 300 million board feet, and nearly all of these are native woods. No data are available as to the amounts of timber used in mines, but it must amount to considerable.

Brazil uses more wood for fuel than for any other purpose. It is practically the only fuel used in the homes and the smaller shops and factories and by the railroads and river steamers, so that the consumption is enormous. On the basis of estimated consumption in the state of Sao Paulo, the total fuelwood consumption of Brazil must be upward of 1,200,000,000 cubic feet a year. The total cut of all material, including poles, posts, piling, house-framing, mine timbers, firewood, and sawed and hewn material is at least 1,300,000,000 cubic feet, and perhaps more.

Loss Through Fires and Other Agencies.—Fire is not an enemy to be reckoned with, in the Amazon forests, because of the humid climate and dense, non-inflammable, evergreen canopy and ground cover. Likewise, fire is not a serious menace to the Atlantic slope forests, except in unusually dry years. In the Parana pine forests and in the drier interior region, however, fires do occur and cause considerable damage.

In the agricultural region large areas of forest are destroyed every year in order to use the soil for coffee, cane, tobacco, and other crops. Most of the timber thus removed is piled up and burned. Much timber also is wasted in logging hardwood forests, because not all species are utilized, and because of the primitive methods that prevail throughout most of the region.

Timber Trade.—*Exports.*—Lumber never yet has been a major item in the foreign commerce of Brazil, either in imports or exports. It has been exported to some extent, however, since the earliest settlement, about 400 years ago, while comparatively limited quantities of construction lumber have been imported for many years. Exports, until recently, have been confined almost entirely to high-grade hardwoods for furniture, fine finish, and similar purposes, and dyewoods. Within the last decade, however, a start has been made toward developing the coniferous forests of southern Brazil, and considerable quantities of Parana pine have been exported from that region to Argentina and Uruguay. Hardwoods have been exported mostly in the log, but recently mills have been built along the shores of Bahia and Espirito Santo, and the exports of hardwood lumber have increased. For many years nearly all of the hardwood exported went to Europe, especially to the ports of Liverpool, Havre, and Hamburg, and the business was largely in German hands. The United States took some rosewood, but more recently has begun to import certain other Brazilian woods, especially Spanish cedar, of which an average of 2,000,000 board feet a year was imported from 1917 to 1920, and the prospects are good for a very considerable increase in this trade. Brazil has supplied an average of 4 per cent of all the United States' imports of cabinet woods since 1917, as compared with 1 per cent during the years preceding the war.

Important species in the export trade are cedro, or Spanish cedar, of which 2,437,000 board feet was exported to the United States alone in 1920; jacaranda, palissandre, or rosewood, of which the total exports during 1913 to 1915 averaged 92,000 cubic feet; massaranduba, 7,500 cubic feet; sebastiao de arruda, about 30,000 cubic feet in 1913; and brazilwood and acapu, small quantities. Previous to 1915, France, Great Britain, and Germany got the greater share of these woods, followed by the United States, Portugal, Belgium, Uruguay, Argentina, Chile, and Italy. Since the war, Argentina has taken the greatest

quantities, followed by Uruguay, Portugal, and the United States. The United States' share is gradually increasing, and amounted to more than 4,000,000 board feet in 1920.

Exports of Parana pine increased from approximately 2,000,000 board feet in 1910 to 10,000,000 in 1913, 27,000,000 in 1915, and 125,000,000 feet in 1918, after which they declined to some extent. In 1915 Argentina took 93 per cent and Uruguay 7 per cent of the total; in 1918 the proportions were 68 and 32 per cent. Exports of hardwoods (lumber and logs) averaged around 5,000,000 board feet for several years after 1910, passed 10,000,000 feet in 1916, and in 1918 were nearly 18,000,000 feet. Figures of total exports in recent years do not all agree, but the average quantity exported appears to be approximately 100,000 metric tons, four-fifths of which is "pine," making about 6,000,000 cubic feet.

The principal wood-exporting ports are Itabapuanha, Rio de Janeiro, Victoria, Bahia, Santos, Paranagua, and Rio Grande. Para and Manaos export small quantities. A large part of the pine exported to Argentina and Uruguay goes through the ports of Sao Francisco and Paranagua, and some goes by way of Sant'Anna do Livramento, Uruguayana, Antonina, and Foz do Iguasso.

Imports.—Imports, while small in the aggregate, have supplied a large part of the requirements for softwood construction material in the seaboard cities. Most of the imported lumber has been yellow pine from the United States, but Canada has furnished considerable white pine and spruce, and Sweden some Scotch pine and spruce. The imported lumber was able to come in on account of its cheapness as compared with domestic material, which was higher-priced because of the scarcity of labor and the inadequacy of transportation facilities in Brazil. In order to promote the development of the home lumber industry, especially in the southern states, heavy duties have been imposed on imported pine, so that in some instances American yellow pine now pays from $15 to $25 per thousand feet. The result of these duties, of course, together with higher mill prices for yellow pine lumber and higher ocean freight rates, has been that imports of yellow pine have fallen off very greatly. Imported hardwoods have never been able to compete with the native kinds. An interesting local condition obtains in the extreme southern part of Rio Grande do Sul, where there is no local timber, and supplies are imported from nearby forests in Uruguay, a country poor in forest resources.

Imports of lumber averaged between 50 and 60 million board feet a year for the decade previous to 1900, then fell to about 20 million feet during the next decade. This decline was caused by the series of tariffs which were imposed for the purpose of fostering the Parana pine industry.

From about 1910, however, imports increased very considerably, amounting to approximately 100 million feet in 1913. The average annual lumber imports just previous to the war were about 80 million feet, of which, roughly, 80 per cent was southern yellow pine from the United States, 10 per cent spruce and white pine from Canada, and 10 per cent spruce and Scotch pine from the Baltic region. With the outbreak of the war, imports again fell off, until in 1917 only about 3 million feet was received. Besides the lumber, match blocks, shooks, staves, and treated ties, equivalent to approximately 10 million board feet a year, were imported. Although small quantities of quebracho ties have been imported from Argentina, as well as some jarrah ties from Australia, their cost is high and native woods answer the purpose as well.

Now that the domestic lumber industry is developing, Brazil will probably never again import as much lumber as she did before the war, and average normal imports under post-war conditions may be estimated at about 20,000,000 board feet, besides shooks and other materials equivalent to 4,000,000 board feet, and about 5,000 tons of paper pulp, making altogether approximately 2,900,000 cubic feet.

Domestic Consumption.—Lumber consumption of Brazil is very small in comparison with that of countries like the United States. Wood is employed in building mostly for ceilings, floors, sash, doors, blinds, and to some extent for framing. Manufacturing industries are not very extensive, and consume only small quantities of wood. After building construction, perhaps the largest amount of lumber is used by box-makers, and the next largest for the construction of cars and other uses by the railroads, of which there were 18,660 miles in 1919. The rubber industry consumes about 4 million board feet per year for shipping rubber. Breweries and bottled water companies require large quantities of wooden boxes, because their product is put up in bottles. Soap, candle, and cigar makers and canners are also large consumers. A great many of the boxes are made over from second-hand boxes. The rubber exporters, for instance, use principally white pine and similar woods, much of which is received in the form of shipping cases for oil cans. Several local woods are also utilized. Other industries use boxes made from various species, including imported white, yellow, and Baltic pines, imported spruces, and the native Parana pine, cedar, and several local softwoods. Most of the population, practically all the railroads, and all the wood-using industries are located within a few hundred miles of the coast. This is the reason why relatively large amounts of lumber have been imported from North America and Europe.

The average annual lumber consumption was estimated a few years ago at 165 million board feet, composed of:

	Bd. ft.
Imported softwood	60,300,000
Imported products (ties, etc.)	4,000,000
Domestic hardwoods	53,660,000
Parana pine	47,400,000
Total	165,360,000

This estimate does not include railroad ties made from domestic woods, of which it is estimated that from 8 million to 12 million are needed annually; or match blocks, of which about 8 million feet a year are imported (choupa, or aspen wood, from the Baltic region). Neither does it include telephone, telegraph, and electric light poles, the consumption of which is comparatively limited except in the southern interior region; piling, which is used in considerable quantity; cooperage, for which a good deal of Parana pine is used in the south for packing maté; or pulpwood, from which 1,200 tons of paper pulp are made. But little wood is used for paving and none for shingles. By far the largest consumption of wood is in the form of fuel, either directly or as charcoal. Almost all the railroads burn wood for fuel, as do many of the factories and most private individuals. Sugar factories, especially, are large consumers. The fuel consumption of the Paulista Railway alone, in the state of Sao Paulo, was 88 million cubic feet in 1916, and the whole state is estimated to consume 350 million cubic feet for railroads, factories, and domestic purposes. Consumption of wood fuel in the states of Parana, Santa Catharina, and Rio Grande do Sul has been estimated at 53 million cubic feet. It seems very conservative to estimate the total fuelwood consumption of Brazil at approximately three times the amount used in these four states, or about 1,200,000,000 cubic feet. The total consumption of all wood is about 1,300,000,000 cubic feet, or approximately 43 cubic feet per capita.

Lumber and Wood-Using Industries.—Although logging has been carried on in the Brazilian forests for four centuries, the logging and lumbering industry is still in its infancy. Methods employed are very crude and wasteful, with a few exceptions, and the resulting products are costly. Until comparatively recently, and even now to a considerable extent, wood was exported in the log. In the hardwood forests, for the most part, hand and animal labor is relied upon in logging, selected trees alone are cut, and only the best parts of them are taken out. Most of the hardwood mills are situated in seacoast towns and buy their logs, usually through middlemen. A great deal of the lumber used locally is sawed by hand. Logs are commonly seasoned for from 6 to 18 months before sawing. In the Parana pine region, on the other hand, although there are numerous small mills of 3 to 5 thousand feet daily capacity, sawing principally for local use, most of the lumber is produced by large

concerns operated according to American methods. These log by machinery and railroad, and saw the lumber in the forest region.

There are more than 250 hardwood mills, some fairly large and well equipped. Most of these are along the coasts of Bahia, Espirito Santo, Rio de Janeiro, and Sao Paulo. The pine industry began to develop with the opening up of that region by a railroad, which commenced operation in 1887. This, together with the Brazilian tariff policy and the conditions brought about by the war, which resulted in a vastly increased demand for Parana pine lumber, has made possible its rapid expansion. Two mills were started in 1887, and shipped their product to Sao Paulo. Now there are about 100 mills, mostly of rather small capacity, in the state of Parana alone. Development is hindered somewhat by poor transportation facilities and by interstate export duties.

Except for the culling out of a few scattered cabinet woods and the supplying of local requirements for towns such as Para and Manaos, no logging has been done in the Amazon region until very recently. Within the past few years, however, a start has been made toward developing the forest resources of the region tributary to Para, and exports of timber from the port of Para increased from about $5,000 in value in 1913, to more than $260,000 in 1918. The states of Maranhao and Piauhy, just east of the mouth of the Amazon, produce some lumber, but exploitation is rather primitive. Exploitation is farthest advanced in Bahia, Rio de Janeiro, Sao Paulo, Parana, and Santa Catharina, while eastern Minas Geraes also produces some lumber.

Rio de Janeiro and Sao Paulo, being better equipped with railroads than the other states, are the centers of wood-working industries and have many modern factories, operated by skilled workmen. Before the war Brazil imported from Europe and the United States furniture and other wood manufactures to the value of a million dollars a year. During the war special efforts were made to develop domestic industries, and the policy of the government now is to encourage manufacture at home, exporting the finished product rather than the raw material.

In 1916, the state of Sao Paulo had factories using wood, as follows:

558 wood-working establishments
383 wagon and carriage factories
304 furniture factories
56 trunk and bag manufacturers
12 match factories
3 paper and paste-board manufacturers

While many of these are small shops, using hand labor, some are large plants, equipped with the most up-to-date machinery.

Forest Management.—Brazil has as yet made practically no start toward handling her forests as a permanent source of wealth. Enormous

areas have been culled and robbed of the most valuable species, or else entirely devastated. This is particularly true in districts contiguous to the larger towns and the railroads, where practically everything is taken for fuel. It is estimated that in the state of Sao Paulo alone about 80,000 acres, with an average stand of 4,000 cubic feet, is cut clear every year for fuel. Devastation has gone so far in the vicinity of Rio de Janeiro that domestic wood fuel has cost more than coal imported from Europe. Methods of logging have been extremely wasteful, especially in the hardwood forests, because ordinarily only the clear butt logs are taken while the less valuable material is left on the ground. Stumpage prices have been very low.

In Sao Paulo, the railroads have done considerable planting, using eucalyptus chiefly.

Forestry Legislation.—Realization of the necessity for conserving the forest resources and stimulating the production of timber did not develop until about 1907, when Parana passed a law encouraging tree-planting. It is true that Minas Geraes had attempted to legislate in favor of her forests as early as 1736, but the law was always a dead letter because it was considered as interfering with the rights of private property.

A decree of July 26, 1911, created four federal forest reserves in Acre territory, which was acquired from Bolivia by the treaty of 1903. Except for these, there are no national forests. Further forest devastation in the vicinity of the capital, however, has been prohibited.

Sao Paulo organized a Forest Service in 1911, whose function is to encourage silviculture and reforestation, and a decree of March 6, 1918, provides bounties for planting eucalypts and certain other species, besides furnishing free of cost seeds, plants, and technical advice.

In December, 1921, the National Congress passed a law which is now in effect, creating a Forest Service (Serviço Florestal) in the Department of Agriculture, Industry and Commerce. Its principal functions, for the present, appear to consist in forestry investigation, education, and statistical work. Provision is made for eventually establishing arboreta, demonstration forests, forest nurseries, and forest schools in each state. The national forests (those of the Acre territory) are to be managed by the Forest Service, and the individual states are invited to give suitable lands for federal reserves. The federal government, with the consent of Congress, may expropriate privately owned lands whose maintenance in forest is deemed essential for protection purposes, and the Forest Service will cooperate with states, municipalities, and private owners in the protection of forests if they request it. The Service is to promulgate regulations to prevent setting of fires by railroads, and is to issue recommendations as to the use of wood fuel by the railroads, covering such

points as the places where cutting may be done, requirements as to replanting cut-over areas with economically valuable species, and the restriction of cutting in hot, dry regions. All government-owned or subsidized roads are required to obey these regulations. Considerable emphasis is laid on research in silviculture, economics, and the preservative treatment of wood, so as to make it possible to utilize the fast-growing native softwoods for general construction purposes.

Secondary Forest Products.—Even though the forests of Brazil hitherto have not contributed large amounts of timber to the world's markets, they have been widely known as the source of other materials, chief of which is rubber. Other products include dyewoods, tanning materials, nuts, vegetable wax, and herva matte, or Paraguay tea.

Rubber.—The forest product for which Brazil has been known best, and which has been of greatest commercial importance, is rubber. *Hevea*, the source of Para rubber, is represented by about ten species, spread over a range of a million square miles. The trees are large. Some species of rubber occurs in every state north of 24 degrees south latitude. The principal ones besides *Hevea* are maniçoba, or Ceara rubber (*Manihot glaziovii*), which grows in the northeastern states; mangabeira (6 or 7 species of *Hancornia*), also native to the eastern and northern states; and caucho (*Castilloa elastica*). Others include balata, maparajuba, and massaranduba (all species of *Mimusops*), which yield a gum of great economic value in British Guiana, not much exploited in Brazil; abiurana, grao de gallo, guapeba, and massaranduba branca (species of *Lucuma*); apui and cuaxinguba (*Urostigma* spp.), gamelleira (*Ficus* spp.); janauba and sucuuba (*Plumeria* spp.); jaqueira (*Artocarpus* sp.); uaca (*Chrysophyllum* sp.); and sorveira (*Couma* spp.).

The most important rubber-producing region is the Amazon basin, comprising the states of Para, Amazonas, and northern Matto Grosso, and Acre Territory. Rubber gathering is almost the sole industry of Amazonas and Acre, which have practically no roads or railroads in their whole extent of 800,000 square miles, while in Para it is the most important industry. The principal rubber-exporting ports are Manaos and Itaquatiara in Amazonas and Belem (or Para) in Para. The latter is one of the most important seaports in Brazil, as it is the gateway for the whole Amazon region of Brazil as well as for large portions of the territory belonging to Ecuador, Peru, Bolivia, and Colombia. The rubber industry is of some importance also in Maranhao and Ceara.

Hitherto this has been an "extractive" industry, consisting in gathering wild rubber from the forests, and has given employment to 15,000 to 20,000 men. Methods have been very wasteful and destructive, and the productive areas have been pushed farther and farther back. The rapid development of the plantation rubber industry in the East Indies

and the resultant decline in prices for rubber have greatly decreased the profits of the wild-rubber industry, and have seriously affected the economic equilibrium in the Amazon region. Until after 1910 this region furnished more than half of the world's rubber supply, but now it furnishes only a very minor part of the total. The relation between production of rubber in Brazil and in the plantations of the Far East is shown in Table 320.

TABLE 320.—PRODUCTION OF RUBBER IN BRAZIL AND THE ORIENT

Year	Brazil	Orient	Year	Brazil	Orient
	metric tons	*metric tons*		*metric tons*	*metric tons*
1905	35,000	146	1912	42,231	28,500
1906	38,000	510	1913	36,615	47,000
1907	37,735	1,010	1914	36,945	70,000
1908	38,080	1,800	1915	37,500	107,000
1909	39,194	3,850	1916	39,000	160,000
1910	38,104	8,230	1917	39,000	210,000
1911	37,973	14,150			

Table 321 shows the effect of reduced prices on the returns received by the Brazilian rubber industry.

TABLE 321.—EXPORTS OF RUBBER FROM BRAZIL

Year	Metric tons	Value (U. S. gold)	Year	Metric tons	Value (U. S. gold)
1911	36,547	$73,261,558	1917	33,979	$35,997,000
1912	42,286	78,125,250	1918	22,662	18,432,000
1914	36,200	33,522,000	1919	33,251	26,384,000
1915	35,195	33,946,100	1920	23,586	.....
1916	31,945	36,537,000			

The Brazilian government has undertaken to encourage the establishment of rubber plantations in districts where the cost of gathering and marketing will be low, and under a law passed in 1912 offers bounties for such plantations, besides furnishing free seeds and technical advice. The greatest present difficulty is the lack of satisfactory labor, which renders difficult competition with the cheap labor of the East Indies. Brazilian rubber, however, is in some respects superior to that grown on the eastern plantations, and it has been estimated that the annual production in Brazil will be maintained at about 35,000 tons a year, possibly increasing considerably as labor and transportation conditions improve.

Brazil imports about 1,000 tons a year of rubber goods, mostly from the United States. Efforts are being made to develop a rubber manufacturing industry at home, so that instead of exporting the rubber and buying back the products the whole industry may be established in Brazil.

Paraguay Tea.—Herva matte, or yerba maté in Spanish, the most generally used beverage of Argentina and southern Brazil, is the forest product next in value after rubber. It is the foliage of *Ilex paraguayensis*, which occurs as an understory of the forests of southern Brazil, eastern Paraguay, and Misiones Territory of Argentina. From 1913 to 1917 average exports were 65,469 tons a year, and in 1919 and 1920 more than 90,000 metric tons a year was exported, valued at over $13,000,000 in 1919 and over $10,000,000 in 1920. About four-fifths of the total goes to Argentina, most of the rest to Uruguay, and some to Chile. Very small quantities are exported to Europe and North America.

Nuts.—Many kinds of nuts abound in the Brazilian forests, and many of them are very valuable, either for food or for industrial use, or for both. Among the important kinds is the coconut, which grows in many parts of Brazil. The principal producing region is along the northeast coast, from Parahyba to Bahia, where more than one and a quarter million bearing trees produce an average annual crop of 50 million nuts. Most of these are consumed locally, but an important export trade may be developed.

Brazilnuts, produced by *Bertholletia excelsa*, are a very important article of export from the State of Para. The crop varies from year to year, consequently exports fluctuate in quantities and value. Recent exports are shown in Table 322.

TABLE 322.—EXPORTS OF BRAZILNUTS

Year	Metric tons	Value (U. S. dollars)	Year	Metric tons	Value (U. S. dollars)
1914	.....	$2,280,000	1918	6,749	$ 925,000
1915	.....	980,000	1919	24,997	5,134,000
1916	.....	1,722,000	1920	9,279	.....
1917	16,057	1,779,000			

The United States takes about 60 per cent of the output, and Great Britain most of the remainder.

Other important varieties of nuts are babassu nuts, which yield an oil similar to that of the coconut, and which are exported to the amount of several thousand tons a year; souari, pekea, or butternuts, yielding

a fat used in making nut butter; and piassava nuts, which are exported as vegetable ivory for the manufacture of buttons. On the upper Amazon are abundant supplies of tagua or jarina nuts (*Phytelephas macrocarpa*), which are exported as vegetable ivory from the west coast countries.

Vegetable Wax, Gums, Oils, and Resins.—Carnauba palm (*Copernicia cerifera*) is the source of a wax resembling bees-wax, which is of considerable industrial importance. The local consumption is large and great quantities are exported. The wax is used locally for making candles, and in other countries for candles, phonograph records, and other products. Exports during recent years are given in Table 323.

TABLE 323.—EXPORTS OF VEGETABLE WAX, BRAZIL

Year	Metric tons	Value (U. S. dollars)	Year	Metric tons	Value (U. S. dollars)
1911	3,214	$1,898,000	1917	3,669	$2,105,000
1912	3,099	1,764,000	1918	4,214	5,108,000
1915	5,897	2,399,000	1919	6,223	5,135,000
1916	4,167	1,914,000	1920	3,515	.....

The United States takes from one-half to two-thirds of the total, Great Britain about one-fourth, and France a smaller amount. The center of production is the six northeastern states, from Pernambuco to Maranhao. There are said to be 15,000,000 carnauba trees in Rio Grande del Norte alone.

Copahyba oil, from *Copaifera* spp., is exported for use in medicine. Other oils and resins, besides those obtained from the palms and other nuts mentioned above, are andiroba oil (from *Carapa*), for illuminating and lubricating oil and soap making; bicuhyba wax (from *Myristica* spp.), for soap and candles; gums similar to gum arabic, from various *Acacias;* gum copal, an ingredient of varnish, from jutahy or locust (*Hymenaea* spp.); and ucuuba oil and tallow, from *Virola surinamensis.* There are several others not so well known, including various gums and resins employed in medicines.

Parana pine is reported to contain considerable resin, which eventually may take the place of the naval stores products now imported from the United States. The importation of these materials has remained at a fairly constant level, subject to temporary fluctuations, since about 1895, and amounts to about 15,000 metric tons of rosin and from 150,000 to 200,000 gallons of spirits of turpentine.

Dyewoods.—Brazil derived its name from a dyewood, the pao brasil

(*Caesalpinia echinata*), which has been exported from the country almost since its discovery. It yields a bright red dye, used in dyeing reds, yellows, and oranges. Exports, which declined considerably with the development of synthetic dyes, increased temporarily during the war to over 200 tons in 1916 and nearly 400 tons in 1917. Other dyewoods of considerable importance, although they do not enter into commerce to a great extent, are:

Grauna, brauna, or maria preta (*Melanoxylon brauna*)
Arariba (*Pinckneia rubescens*, and *Centrolobium* spp.)
Urucu (*Bixa orellana*)
Pao cravo (*Dycipetallum caryophillotum*)
Pao sangue (*Vismia latifolia*)
Roxinho, pao roxo, guarabu (*Peltogyne guarabu*)
Sangue de drago (*Croton salutaris*)
Urucurana (*Croton urucurana* and *C. erythrina*)
Tatajyba(*Maclura affinis* and *M. brasiliensis*)
Tatauba (*Morus*, or *Chlorophora, tinctoria*).

Although some thirty or more trees yield dyes from their wood, bark, fruit, or leaves, they are not utilized except to a limited extent locally.

Tanning Materials.—Many Brazilian trees and plants are rich in tannin. Perhaps the most abundant are the mangroves, of which there are extensive areas in the Amazon delta region, as well as at other points along the coast. Large quantities of bark and leaves are used in the tanneries of southern Brazil, and considerable has been exported. Other important sources of tannin include:

Barbatimao (*Stryphnodendron barbatimao*), whose bark is from 48 to 60 per cent tannin, and which is common in the temperate regions of Minas Geraes, Sao Paulo, and Goyaz.

Angico (*Piptadenia rigida*) is widely distributed, especially in Minas Geraes.

Monjolo branco, or jacare (*Enterolobium monjolo*), is abundant in Rio de Janeiro, Espirito Santo, and Minas Geraes.

Jequitiba rosa (*Couratari legalis*).

Burahem de casca doce (*Glycisophyllum burahem*).

Divi-divi (*Caesalpinia coriaria*), the fruit pods of which contain from 40 to 45 per cent of tannin, occurs in the dry forests of the northeastern states.

Guara (*Paullinia sorbilis*) has about 55 per cent of tannin in its pods, and makes light colored leather similar to that produced by cascalote.

Quebracho (*Quebrachia lorentzii* and *Schinopsis balansae*), which occurs in the southern part of Matto Grosso, has been too remote to be exploited.

Acacias of several species are common in the drier parts of the eastern and southern states, and their bark contains a high per cent of tannin.

In addition, approximately 100 other species are listed as of value for tanning, and many of them are used locally.

As the interior plains region of Brazil will eventually produce very large quantities of cattle and other stock (hides already form one of the most important products of Brazil), the tanning industry is bound to develop and the local tannin resources will be drawn upon to their capacity. Already it is reported that local supplies are practically exhausted in Sao Paulo, Rio de Janeiro, and eastern Minas. Considerable quantities of bark have been exported to Germany and Portugal from Parana, Rio Grande do Sul, and Sao Paulo.

Paper Pulp.—Although Brazil has many fast growing trees with soft, light-colored wood which eventually will be used for making paper pulp, the local industry is not yet developed, and most of the paper manufactured in the country is made of imported pulp. About 5,500 to 6,500 metric tons was imported in a normal prewar year, and of this amount 85 to 90 per cent came from Sweden, Norway, and Russia. While about the same quantity was received in 1919, one-third came from the United States. In 1920 the imports were 9,000 tons, of which Sweden, Norway, and Finland furnished 90 per cent, and the United States less than 1 per cent.

Normal imports of paper average between 30 and 35 thousand tons, of which approximately 25 thousand tons is newsprint. In 1919 and 1920 imports averaged 45,000 metric tons. Before the war Germany furnished from 40 to 45 per cent of the print paper, and Norway and Sweden from 15 to 20 per cent each, while smaller quantities came from the Netherlands, Belgium, Austria, Great Britain, Italy, France, and the United States, in the order given. In 1920 the United States furnished 15 per cent of the newsprint and about 40 per cent of the other paper, while Norway, Finland, and Sweden furnished most of the newsprint.

In 1917 there were 14 paper mills in Brazil, making cardboard and wrapping paper at the rate of about 50 tons of paper and 40 tons of cardboard daily. The value of paper and paper manufactures imported in 1919 was over $11,600,000 (U. S. gold). One pulp mill was started in 1916, to produce pulp from local woods, and others have been planned, to be established within a few years. Water power is available in almost unlimited amounts, especially in the eastern and southern states. More than 60 species have been listed as probably suitable for paper pulp. Among the more important of these are:

Marupa (*Simaruba officinalis*)
Mongubeira (*Bombax monguba*)

Muiratinga (*Perebea* and *Olmedia* spp.)
Imbirussu (*Bombax* spp.)
Imbauba (*Cecropia* spp. and *Pourouma* spp.)
Sumauma (*Ceiba pentandra* and *C. sumauma*)
Pinho (*Araucaria brasiliana*)

It has been estimated that one acre of Parana pine forest, on the better sites, will yield 60 tons of pulp. The average, however, will be much less.

Products of Distillation.—Although this industry has not yet been established, it offers an almost unlimited field for future exploitation, either independently or in conjunction with the timber industry. Analyses of a few species common in Matto Grosso showed the following results, per 100 kilos of wood:

TABLE 324.—YIELDS FROM DISTILLATION OF 100 KILOGRAMS OF WOOD

Species	Pyroligneous acid	Resins	Charcoal	Acetic acid	Methyl alcohol	Acetone
	liters	*liters*	*kilos*	*grammes*	*grammes*	*grammes*
Quebrachia lorentzii	41.41	2.19	39.87	3,975.4	581.1	177.7
Tabebuia flavescens	42.16	8.33	31.83	6,324.0	1,044.3	181.7
Aspidosperma quebracho blanco	44.30	7.50	35.76	6,910.8	1,832.7	179.4
Cordia frondosa	44.61	4.87	33.14	.....	.....	.....
Bulnesia sarmientii[1]	33.43	7.23	29.85	3,409.0	1,024.3	160.1
Piptadenia cebil	41.89	3.25	36.08	5,517.6	821.8	193.1

[1] And green oil, 14.88 liters.

The Outlook for the Future.—Almost the only Brazilian woods that have been important in the export trade have been cabinet woods, dyewoods, and others for special purposes, mostly very hard or deeply colored and of kinds that occur only scatteringly in the forests. On this account the idea has prevailed that these great forests can never be important sources of construction timber or of other soft woods for the uses for which the softwoods of the northern hemisphere are suited, and that whatever hardwood timber they produce must inevitably be extremely high in price, because of the excessive costs of logging and transportation.

According to the testimony of numerous competent persons, however, such ideas are founded on a misconception of the facts. One states, for instance, that in the mountains of Bahia the bulk of the stand is composed of about 10 species, and that 42 per cent of the volume is of soft

woods, corresponding to yellow poplar; 30 per cent of medium hardness, corresponding to maple, ash, and oak; and only 28 per cent harder than white oak. Similar conditions are reported to prevail in the "terra firme" forests of the Amazon region, while in the lowland forests the proportion of softwoods is greater.

Table 325 shows the classification according to specific weights of 213 different woods described by one writer. This list, of course, represents but a small fraction of the total number of species, and does not give any indication as to the relative abundance of the different kinds of wood described. Moreover, it was prepared more than 40 years ago, when many of the softer and less durable woods probably would have been overlooked.

TABLE 325.—SPECIFIC WEIGHTS OF BRAZILIAN WOODS

Corresponding North American species	Specific weight (approximate)	Number of Brazilian woods.
Cottonwood, willow	0.450 and under	2
White pine	0.450 to 0.500	8
Chestnut, yellow poplar, shortleaf pine, etc	0.500 to 0.550	7
Maple	0.550 to 0.650	10
Red oak, etc	0.650 to 0.750	37
White oak	0.750 to 0.850	31
Hickory	0.850 to 1.000	50
Persimmon and heavier	1.000 and over	68

Logging costs have been almost prohibitive in the past, because of inadequate development of transportation facilities, scarcity of labor, and the practice of selecting only a few species, and those some of the least abundant. These conditions, together with the fact that most of the population has been and still is close to the coast, where imported woods can be brought in cheaply, explain why the native interior forests have remained undeveloped. The even nature of the topography—practically none of it more than 1,000 feet above sea-level—and the network of navigable rivers, of which there are 27,000 miles in Brazil, very largely in the Amazon Valley, combine to make the Amazon region one particularly well adapted for large-scale logging operations at comparatively low cost.

A glance at the map shows that the mouth of the Amazon is closer to the Mediterranean countries than are the Atlantic ports of the United States, and, except for Egypt and Syria, it is nearer these countries than

are the forests of the East Indies. It is not so far from the Mediterranean and other European countries as are the great tropical forests of central Africa. Moreover, the Amazon region is less distant from English Channel ports than are the Gulf ports of the United States, and is almost as near as American Atlantic ports. The distance from the east coast of the United States to the mouth of the Amazon is about the same as the distance overland from the Atlantic to the forests of the Pacific Northwest, and is much shorter than the water route via the Panama Canal. South Africa, which will probably import considerable quantities of wood for many years, is as near to the Amazon as it is to the forests of the East Indies. The Amazon is navigable for ocean steamers throughout its whole length in Brazil, so that the timber of the interior is practically as accessible as that nearer the coast. These facts, together with the growing inadequacy of the northern coniferous forests to supply the world with construction timber, indicate that the great equatorial forest of Brazil will sooner or later contribute large quantities of wood to the world markets.

The hardwood forests and the Parana pine forests of southern Brazil have a great, practically treeless region to the southwest, just as the Lake States' pineries of the United States had. This region is already the greatest lumber-consuming region of South America, and may be expected to increase its demands very greatly. Hitherto a large part of its supplies have come from the southern pine forests of the United States, which cannot much longer supply the demands. Already, Argentina and Uruguay are drawing on Brazil for timber, and they will undoubtedly continue to do so on an increasing scale.

As for Brazil itself, the population is increasing, and according to most recent statistics is now slightly more than 30 millions. Industrial development is hardly more than started, and agriculture may reasonably be expected to develop enormously within the next few decades. Besides her 27,000 miles of navigable rivers and 4,000 miles of coastline, Brazil now has nearly 19,000 miles of railroads, having extended the mileage considerably since the outbreak of the European war. The railroad system will doubtless be pushed farther into the interior, and greater industrial and agricultural expansion will follow. There will also be a considerable expansion of the mining industry. It has been predicted that the domestic demand for timber will more than double during the next 20 years, and there seems to be no reason for doubting such a prediction.

To develop the Brazilian forests so as to make them a factor in the world markets will require large-scale operations, with much capital. Human labor and that of animals will have to be replaced as far as possible by machinery. Better methods of logging, milling, seasoning,

preservative treatment, utilization, and marketing, especially adapted to tropical woods, will have to be devised. And finally, if the forests are to be maintained as a permanent source of world supplies, and they no doubt will be to a considerable extent, they must be so handled as to produce larger quantities of the more valuable species, gradually eliminating the less important ones. There will be a tendency to replace the present complex stands with stands composed of only a few species, mostly of rapid growth, and all of great commercial importance, such as cedro, massaranduba, ucuuba, andiroba, pequia, louros, and a few softwoods suitable for box-lumber or pulpwood, in the Amazon region, and some of these species and also canellas, perobas, and others in the eastern forests. In this way, not only will the costs of management and exploitation be reduced, but the productivity of the forests will be increased.

Brazilian Woods.—While the total number of tree species native to Brazil is unknown, it probably exceeds 3,000. In the Amazon basin there are said to be 2,500 species, of which about 50 are very high-grade cabinet woods and many others of economic value equivalent to maple, yellow poplar, ash, hemlock, or spruce of North America. A hundred or more different Brazilian species are used to a considerable extent for construction work now, and there are many species especially adapted for bridges, piling, railroad ties, and other uses where strength and durability are requisites. Many others make excellent handles, spokes, turned articles, and woodenware of various sorts. A few of the more important woods are given below:

TABLE 326.—MOST IMPORTANT WOODS, BRAZIL

Acapu (*Vouacapoua americana*) has dark greenish, heavy (about 70 pounds per cubic foot), hard, strong wood, which is extensively used for civil and naval construction and furniture. Much is sent from Para to the other states, and considerable is exported to Europe.

Acoita cavalhos (*Luhea* spp.) has soft, light wood (33 to 35 pounds per cubic foot), used for interior construction, chairs, brush backs, saddles, and wooden legs.

Aderno (*Astronium commune*) and aderno preto (*A. concinum*) have light red wood, weighing from 50 to 65 pounds per cubic foot, and used for construction, furniture, posts, and ties.

Andiroba (*Carapa guianensis*) resembles mahogany, for which it is sometimes substituted. The wood is hard, stiff, moderately heavy (45 pounds per cubic foot) and is used for furniture and construction. The seeds yield an oil used in soap making and for illumination. Cumussiu (*C. grandiflora*) is similar.

Angelim pedra (*Andira spectabilis*) is a large tree with dark red, heavy wood, weighing from 60 to 72 pounds per cubic foot, durable in moist situations, and used for naval and land construction, ties, and vehicles. There are 5 or 6 other angelims (*Andira* spp.) with wood weighing from 39 to 58 pounds per cubic foot, and used for construction, furniture, posts, and cooperage.

Angico (*Piptadenia rigida* and *P. colubrina*) has red wood, streaked with yellow, with coarse, interwoven grain, and difficult to work, but durable. It weighs from 50

TABLE 326.—MOST IMPORTANT WOODS, BRAZIL—*Continued*

to 67 pounds per cubic foot, and is used for civil and naval construction, ties, and posts. The bark is rich in tannin, and yields a gum used in hat manufacture. The tree grows rapidly.

Araça includes several species of *Psidium* and *Britoa*, which have rather hard, heavy wood (60 to 65 pounds per cubic foot), used for construction, posts, furniture, turnery, and tool handles.

Arapoça amarella (*Raputia magnifica*) has heavy wood (63 to 75 pounds per cubic foot), used for hydraulic construction, exterior and interior finish, and cabinet work. Arapoça branca (*R. alba*) is lighter (45 to 50 pounds) and is used for about the same purposes.

Arariba vermelha and arariba rosa (*Centrolobium robustum* and *C. tomentosum*) are large trees with pink or yellowish wood, weighing from 42 to 62 pounds per cubic foot, used for interior and exterior construction and cabinet work. Ties of arariba rosa last 11 years or more in service, and some telephone poles are made of it.

Aroeira vermelha (*Schinus terebinthifolius*) furnishes excellent wood for construction, cabinet work, posts, poles, and barrel staves. It weighs from 65 to 80 pounds per cubic foot, is difficult to work, and is very durable. Aroeira molle (*Schinus molle*) and aroeira branca (*Lythraea molleoides*) have similar uses.

Assacu (*Hura crepitans* or *H. brasiliensis*) is a very large tree with soft, light wood, used for ceiling, flooring and interior finish.

Bacury (*Platonia insignis*) is used for civil, naval, and hydraulic construction.

Barbatimao (*Stryphnodendron barbatimao*) has very hard, heavy wood (about 80 pounds per cubic foot), used for construction, cabinet work, and turnery, but especially valuable for its tannin and for a dye.

Bibiru or greenheart (*Nectandra rodiei*) occurs in extreme northern Brazil. It is one of the best known trees of British Guiana, but is not yet exploited in Brazil.

Bicuhyba (*Myristica* spp.) has light-colored wood which turns red with exposure, and it is fairly soft, light (43 to 50 pounds per cubic foot), and easy to work. It somewhat resembles cedro, but is darker. Used for general construction, cabinet work, shingles, canoes, and barrels. It yields a wax which is used in soap and candles.

Bracuhy or gracuhy resembles angelim, and has wood which is yellow in color, heavy (60 pounds per cubic foot), cross-grained and knotty, and easy to saw but difficult to plane. Used for exterior construction.

Brauna, grauna, or maria preta (*Melanoxylon brauna*) has dark brown, coarse, straight-grained wood, which is very difficult to work. It is one of the most durable woods of Brazil, lasting over 100 years exposed to the weather. It is widely used for outside construction, ties, and piles.

Burity or mirity palm (*Mauritia flexuosa*) is used for floats, its leaves for thatch, and its nuts for vegetable ivory.

Cabreuva (*Myrocarpus fastigiatus* and *M. frondosus*) has grayish brown wood, weighing from 50 to 75 pounds per cubic foot, and slightly resembling teak. It occupies a place in southern Brazil similar to that of white oak in North America, being used for furniture, ornamental work, car building, handles, staves, and interior trim.

Cacunda has fine-grained yellow wood, excellent for construction, and much used in furniture.

Caixeta or pao parahyba (*Simaruba diversicolor*) has light-colored, straight-grained, slightly porous wood, which saws and works easily and can be carved. It is soft and light (25 to 35 pounds per cubic foot), and is used in interior work where strength is not a requisite. It makes good pulp.

Canellas include some 25 species of *Nectandra* and *Ocotea*, all of which are of economic

TABLE 326.—MOST IMPORTANT WOODS, BRAZIL—*Continued*

importance. Among the best are: canella parda (*N. amara*), which resembles black walnut, is moderately heavy, very durable, and widely used for lumber, naval construction, ties and exterior work in general; canella capitao mor (*N. myriantha*), which makes first-class ties and is much used for flooring and exterior work; canella batalha (*N. robusta*), which is light colored, easy to work and polish, takes varnish well, and is used for high-grade cabinet work; canella preta (*N. mollis*) has brownish gray wood, weighing about 55 pounds per cubic foot, used for flooring, trim, ceiling, cabinet work, posts, and ties; canella sassafras (*Ocotea pretiosa*), which has brown or greenish wood, used for high-grade furniture and interior decoration. It is too high-priced for general use in carpentry. Ties of this wood last for 11 years or more. Most of the canellas correspond, more or less, to maples or oaks of North America.

Cangerana (*Cabralea cangerana*) has wood which is fairly light (42 to 50 pounds per cubic foot), reddish, durable, easy to work, takes varnish well, and is used with cedro for finish and cabinet work. It resembles mahogany.

Carvalho, sobro, or catucahem (*Roupala* or *Rhopala brasiliensis*) has heavy red wood with twisted fibres, difficult to work, but used for construction, cabinet work, axles, and ties.

Castanheiro do Para (*Bertholletia excelsa*) is a large tree with excellent hard wood, used for construction and posts. It is best known for its nuts (brazilnuts), which are sold in large quantities.

Cedro (*Cedrela brasiliensis, C. fissilis, C. glaziovii*) are among the most important trees of Brazil. They are very similar to *C. odorata*, the Spanish cedar of the West Indies, and are used for the same purposes. The wood is light (27 to 46 pounds per cubic foot), durable, strong, and easy to work. The tree grows rapidly and reaches large size. It produces saw-timber in 15 years or less.

Chibatao (*Astronium gracile*) has wood weighing about 60 pounds per cubic foot, light brown, with an interwoven grain and rather difficult to work, but first class for ties and rough construction.

Copahyba, pao de oleo, or oleo branco (*Copaifera langsdorfii, C. martii*, and *C. officinalis*) has dark red, wavy-grained, hard wood, resembling mahogany. It is a first-class wood for carpentry, cabinet work, wheels, general construction, masts and ties. It is resinous and very durable in moist situations. From the resin is made oil of copahyba, used in medicine.

Embirussu, imbira, or imbirussu (*Bombax* spp.) are large trees with soft, light, rather perishable wood, used for canoes, boxes, and cheap lumber, and suitable for paper pulp. The bark yields a fiber, and the fruit a silky cotton similar to kapok. The wood weighs about 32 pounds per cubic foot.

Frei jorge (*Cordia goeldiana*) has excellent hard wood, resembling teak.

Genipapo or genipapeiro (*Genipa americana*) is a large tree with light-colored, fine-grained, moderately light wood (42 to 52 pounds per cubic foot), which is very flexible, easy to saw, plane, and varnish, and much used for fine cabinet work, flooring, vehicle construction, and tool handles.

Gonçalo alves, or kingwood (*Astronium fraxinifolium* and *A. graveolens*) has reddish-brown figured wood, weighing about 60 pounds per cubic foot, and rather difficult to work, but much used and exported as a cabinet wood. It is also excellent for wheels, floors, ties, and general construction.

Grapiapunha, or garapa amarella (*Apuleia praecox*) has light yellow, hard, resistant wood, excellent for railroad ties, and also used in construction, cabinet work, and turnery. It weighs about 50 pounds per cubic foot.

TABLE 326.—MOST IMPORTANT WOODS, BRAZIL—*Continued*

Grumixameira or grumichaba (*Eugenia brasiliensis*) has light wood (37 to 47 pounds per cubic foot), used for carpentry, cooperage, and boxes.

Guapeba or guapeva (*Lucuma laurifolia*) has yellow, coarse-grained, strong wood, which is rather hard to work and not durable in moist situations. It is used for posts and rough construction.

Guarabu, amarante, or pao roxo (*Peltogyne confertiflora*, *P. discolor*, *P. densiflora*, and *P. venosa*) have violet-red, straight-grained, strong, elastic wood, weighing from 52 to 63 pounds per cubic foot, rather hard to work, but excellent for spokes, hubs, naval construction, cabinet work, and ties. Some is exported.

Guarita, guariba, or caobi, has light red wood, with dark veins, which is hard to work and very resistant to bending, and much used for cabinet work. It weighs about 60 pounds per cubic foot.

Guatambu (*Aspidosperma macrocarpum*) weighs about 50 pounds per cubic foot, has light-colored, strong, compact wood, very resistant to bending, and easy to saw, plane, and polish. It is used for wheels, ties, agricultural implements, and cabinet work.

Imbauba or embauba (*Cecropia* spp. and *Pourouma* spp.) are fast-growing trees, especially common on cut-over lands. The wood is soft and believed to be suitable for pulp. The bark yields a useful fiber.

Imbuia or embuia (*Nectandra* sp.) is one of the most important hardwoods of southern Brazil, where it is cut in large quantities. Its wood resembles that of black walnut, weighs about 55 pounds per cubic foot, saws, planes, and polishes well, keeps its shape, and lasts for 15 or 20 years as railroad ties. It is as good as walnut for airplane propellers, and is very extensively used for furniture and interior finish, as well as in construction and for ties. Imbuia has also been identified as *Bignonia paraensis*.

Ipé includes several species of *Tecoma* and some other genera. Ipé tabaco (*T. pedicellata*) furnishes one of the best construction woods of Brazil, although it is difficult to work because of its hardness. It has dark-colored, very stiff wood, weighing from 62 to 73 pounds per cubic foot, and is used for piling, bridges, ties, wheels, handles, and cabinet work. Ipé preto, ipé roxo, or ipé una is similar, and is used especially for furniture and construction.

Itauba, ironwood, or stonewood (*Silvia itauba*), has very hard, almost indestructible, strong, elastic wood, used for naval construction and carpentry.

Jacaranda, palissandre, or rosewood, includes several species of high-grade, deeply colored cabinet woods, mostly species of *Machaerium* and *Dalbergia*. The true rosewood or jacaranda cabiuna (*D. nigra*, or *D. spruceana* in Amazonas), is deep wine colored, with darker streaks; is hard, strong, and elastic, and takes a high polish. A ton of logs produces about 250 board feet of lumber, as the logs are usually defective. It has been exported for more than 200 years, and is used for veneer for pianos, pool tables, showcases, furniture, fixtures, crutches, brush backs, and turned articles. Jacaranda preto (*M. incorruptible* and *M. legale*), and jacaranda roxo (*M. firmum*) are similar in properties and uses. There are also several others, all excellent woods.

Jarana (*Chytroma jarana*) resembles white oak, and has much the same properties of strength and durability. It is used in ship-building and for ties.

Jequitiba rosa (*Couratari estrellensis*) is one of the largest trees of Brazil, frequently attaining diameters of 7 feet or more, and sometimes much larger. The wood is reddish, straight-grained, easy to work and finish, and resembles cedar. It is light in weight, ranging from 40 to 44 pounds per cubic foot, and is widely used for build-

TABLE 326.—MOST IMPORTANT WOODS, BRAZIL—*Continued*

ing, interior work, and boxes, and as a substitute for pine. Jequitiba amarella and jequitiba branca, while lighter and not quite as good, make good boxes.

Jutahy, jatahy, jatoba, or locust (*Hymenaea coubaril*, and 5 or 6 other species) is the source of a widely used wood of moderate weight (53 to 75 pounds per cubic foot), red and yellow in color, strong, stiff, durable, and easy to work and finish. Much is used for cabinet work, wheel-making, hydraulic construction, and ties. The resin is exported as copal, used in varnish.

Louro includes several species of *Cordia*, *Nectandra*, and other genera, practically all of which furnish important construction and cabinet woods. One of the best is louro pardo (*Cordia hypoleuca*, and *C. excelsa*) which weighs about 55 pounds per cubic foot, has a fine interwoven grain, is easy to work, and is used for high-grade furniture, finish, doors, and panelling. The louros in general are the cheapest commercial woods of Brazil, and are widely used for construction, boxes, and cooperage. They are not very strong or durable, nor do they resist termites.

Macacauba (*Platymiscium paraense*) is a valuable cabinet wood species of the Amazon.

Mangabeira (*Hancornia* spp.) yields "mangabeira" rubber, and the wood is used to some extent for construction.

Marupa or marupauba (*Simaruba amara* or *S. officinalis*) is a large tree with light soft wood (34 pounds per cubic foot), of rapid growth, and suitable as a substitute for pine, for boxes and light construction. It has the further advantage of being termite-resistant. It is also a possible pulpwood.

Massaranduba vermelha (*Mimusops elata*) has one of the best woods for heavy construction, hydraulic construction, and all work where strength and durability are required. Its wood is red, fine-grained, stiff, heavy (68 to 73 pounds per cubic foot), but easy to work. It is used also for cabinet work, flooring, vehicles, ties, and posts. The bark is used for tanning, and the tree yields a rubber or balata. There are several other kinds of massaranduba, including several species of *Mimusops* and *Lucuma*. Still other *Mimusops* species are known as maparajuba. All are good woods.

Mangue or mangrove includes *Conocarpus erectus*, *Laguncularia racemosa* (mangue branco), *Avicennia nitida* and *A. tomentosa* (siriuba), and *Rhizophora mangle* (mangue vermelho). All are of value for tanning, but the last named is most important. Its wood is also used in construction, and is especially good for fuel.

Mata-mata (*Eschweilera matamata*) resists teredo, and yields an excellent timber for heavy construction, under water or on land.

Milho cosido (*Licania incana*) has wood which weighs from 50 to 60 pounds per cubic foot, is yellow, fine-grained, hard, rather difficult to work, and employed for construction and furniture. The bark is used for tanning.

Mongubeira, monguba (*Bombax monguba*) is a large tree with soft, light wood, used for canoes, woodenware, and boxes, and suitable for pulp. The bark yields a valuable fiber, and the fruit a silky cotton like kapok.

Muiracoatiara (*Centrolobium paraense*) furnishes fine cabinet wood.

Muirapenima or letter wood (*Brosimum discolor* and *B. guianensis*) has very hard, heavy, richly colored cabinet wood, utilized for doors, frames, canes, and fine furniture. Muirapiranga (*B. paraense*) is similar.

Oity (*Moquilea tomentosa*) has light pink wood, moderately light (40 to 50 pounds per cubic foot), durable in water but not in the air, and employed in boat-building and under-water work. There are several kinds of oity.

Oiticica (*Soaresia nitida*) has light red, coarse-grained wood, weighing about 47 pounds per cubic foot, easy to work, and used for interior finish and the insides of furniture.

Oleo vermelho, or balsamo (*Myrospermum erythroxylum*, or *Myrocarpus* sp.) has wood which weighs from 50 to 65 pounds per cubic foot, is reddish, fine-grained, easy to

TABLE 326.—MOST IMPORTANT WOODS, BRAZIL—*Continued*

work, and resembles mahogany. It is used for fine furniture, finish, ties, and parts of carriages.

Parapara (*Cordia tetrandra*) is an abundant tree with soft pulpy wood, used for interior work, and probably suitable for pulp.

Pao amarello or satinwood (*Euxylophora paraensis*) is a tree of the lower Amazon valued for cabinet wood.

Pao brasil, ibirapitanga, pao Pernambuco, or brazilwood (*Caesalpinia echinata*) is best known as a dyewood. The wood is bright red, with dark streaks, fine-grained, hard, heavy (60 to 84 pounds per cubic foot), very durable in construction work, and fairly easy to work and polish. It is utilized in fine cabinet and inlay work.

Pao d' arco, roble blanco, white cedar (*Tabebuia pentaphylla*) is a large tree, with yellow or light brown, hard, elastic wood, used in building, naval construction, and furniture. A related species (*Tecoma conspicua*) is the pao d'arco of the Amazon region, which is employed for construction, ties, telephone poles, wheels, and staves.

Pao ferro, or quiripyranga (*Apuleia ferrea*) has very heavy (75 to 85 pounds per cubic foot), hard, strong, cross-grained, dark red wood, difficult to work, and used for ties, posts, piling, vehicles, and some building construction.

Pao mulato (*Calycophyllum spruceanum*) is a fine cabinet wood species of the Amazon.

Pao pereira (*Aspidosperma subincanum*) has wood which weighs about 50 pounds per cubic foot, and is used for construction, cabinet work, cooperage, and agricultural implements. Its bark contains tannin.

Pao rosa, pao cravo, or Sebastiao de arruda (*Physocalymma florida*, or *P. scaberrima*) has very fine reddish, yellow, or rose-colored cabinet wood, called bois de rose in France. It should not be confused with true rosewood (*Dalbergia*). Another similar wood is *Aniba parviflora*, of the Amazon region.

Pequea, pequia marfim, pao liso, pao setim, or ivory wood (*Aspidosperma eburneum*) has very fine-grained yellow wood, which works, planes, and polishes well and resembles old ivory. It is used in inlaid work, toys, carving, and fine cabinet work, and is exported in some quantity. It weighs about 50 pounds per cubic foot.

Peroba includes about 15 species of *Aspidosperma*. They are abundant, the woods are easy to work, only moderately heavy, and are the most generally used woods of Brazil, occupying a place in industry corresponding to the oak of Europe, or the oaks, birches, and maples of the United States. They answer practically all purposes for which imported hardwoods are brought in, and even compete with yellow pine for construction and flooring. Several species are exported as furniture woods. Among the best species are: Peroba amarella (*Aspidosperma peroba*), which has golden yellow wood, much used for flooring, furniture, vehicles, and ties; peroba parda (*A. gomesianum*), with grayish yellow wood, widely employed for carpentry, cabinet work, vehicles, ship-building, and ties; peroba rosa (*A. polyneuron*), a very large tree, with pale rose-colored wood, used for fine finish and furniture, and for ties; and peroba revessa, which resembles birdseye maple, and is used for fine cabinet work.

Pinho or pinheiro do Parana (*Araucaria brasiliana*) reaches large size, some individuals attaining diameters of 10 feet. The wood is yellowish white, streaked with pink, is straight-grained, light in weight (21 to 35 pounds per cubic foot), works fairly well, but is difficult to season without warping and checking, and is suited for general constructional use and for box material. There are said to be two varieties, the white (branco), which is soft, perishable, and suitable for boxes, pulp, and temporary construction, and the yellow (vermelho), which is as good as American yellow pine. It is probable that these differences are due to the conditions of growth or to the relative proportions of sap and heartwood.

TABLE 326.—MOST IMPORTANT WOODS, BRAZIL—*Continued*

Piquia and piquia-rana include *Caryocar villosum* and several other species. The wood weighs from 50 to 60 pounds per cubic foot, is strong and elastic, and is used for vehicles, ties, posts, construction, and turnery.

Piuna or peuna (*Tecoma longiflora* or *T. araliacea*) has coarse-grained, dark brown, heavy wood, difficult to work and utilized for poles, ties, construction, vehicles, and cooperage.

Sapucaia includes many species of *Lecythis*, which are among the most abundant trees of the Amazon and widely distributed over most of the other forest regions. They are large trees, with fairly heavy, hard wood of excellent quality for construction, ties, cabinet work, and other uses. Among the best known are sapucaia grande (*L. ollaria*) which has dark red wood; sapucaia vermelha (*L. pisonis*), with dark pink wood; sapucaia branca (*L. lanceolata*), lighter in color and weight; sapucaia mirim (*L. angustifolia*), redder and heavier. Putumuju, with light brownish-yellow wood, belongs to the same family. Most of these trees bear nuts which are of value for food or for oil.

Seringueira (*Hevea brasiliensis* and several others) yields Para rubber. It reaches large sizes, and the wood would be of economic value if the tree were not more valuable for the gum.

Sucupira, sibipira, or sapupira (?) (*Bowdichia virgilioides* and *B. nitida*) have yellowish brown, strong, flexible wood, rather hard to work, but employed for carpentry, naval construction, axles, ties, and cabinet work. The bark is used for tanning. The wood weighs from 50 to 68 pounds per cubic foot

Sumauma, or sumaumeira (*Ceiba pentandra* and *C. sumauma*) are abundant, large trees with soft light-colored wood, used for canoes, light construction, and woodenware, and suitable for pulp. The fruit yields a silk cotton.

Timbouva (*Enterolobium timbouva*) has soft, light brown wood, weighing about 22 pounds per cubic foot, used for construction, furniture, woodenware, and vehicles, and suitable for paper pulp. It is one of the largest trees of Brazil.

Ucuuba (*Virola surinamensis* and *V. sebifera*) has dense, reddish brown wood somewhat like mahogany. It is utilized for carpentry and cabinet work. The fruit yields "myristina," a vegetable wax of commercial value. The tree is abundant in the Amazon lowlands.

Umiry (*Humiria floribunda*) has wood which weighs about 50 pounds per cubic foot, and is used in civil and naval construction and carpentry.

Urucurana (*Hieronyma alchorneoides*) has wood which weighs about 60 pounds per cubic foot, is light brownish yellow, straight-grained, rather coarse in texture, very stiff, but works easily. It is used for rough construction, bridges, and spokes. Another species of the same name (*Croton urucurana*) is somewhat similar. Its bark contains tannin.

Vinhatico, or Brazilian mahogany (*Enterolobium ellipticum*) is a very common tree, and one of the best for general purposes, after peroba and canella. Its wood weighs from 30 to 44 pounds per cubic foot, or about the same as chestnut and yellow poplar; reaches large sizes, is easy to work and to season, and takes a fine finish. It is reddish yellow, with some resemblance to mahogany. It is extensively used for construction, finish, furniture, and boats, and is said to be as good as true mahogany for airplane propellers. There are several other woods called vinhatico, including vinhatico amarello (*Echinospermum balthazarii*), a yellowish wood, used for flooring, interior trim, and furniture; vinhatico de espinho (*Pithecolobium tortum*) used for interior work, furniture, handles, and turnery; and vinhatico do campo (*Plathymenia* spp.), valuable for construction, finish, and furniture.

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BRITISH GUIANA

Distribution and Extent of Forests.—Forests cover about seven-eighths (86.9 per cent) of the total area of British Guiana. The alluvial belt along the coast, which varies from 5 to 35 miles in width, and is flat and but little above the sea level, toward the east is in considerable part open savanna land, and there are also extensive savannas in the southern and southwestern parts of the colony. The northeastern savannas cover about 5,500 square miles, while those of the interior cover 6,200 square

miles. About 900 square miles near the coast is occupied by towns or is cultivated, and the remaining 77,780 square miles (49,780,000 acres) is covered with forest. There are 160 acres of forest per inhabitant. Under present conditions only the northern part of the colony, extending inland from 35 to 110 miles to the first series of falls and rapids on the large rivers, is easily accessible and available for development. In this region is 13,000 square miles of forest, leaving 64,780 square miles of forest not yet of commercial value because of its location, although its potential value is as great as that of the accessible forests. The forest area is not being reduced to any appreciable extent, and probably will remain at approximately the present figure for many years.

Character of Forests.—Practically all of the forests belong to the mixed evergreen type, but there are a great many local variations due to drainage and topography, and in many localities one or a few species predominate sufficiently to make almost pure stands. Two general classes of forest may be distinguished: (1) those on swampy lands; and (2) those on the better drained uplands.

Forests of the swamp lands include belts of mangrove along the coasts and estuaries; mixed forests, with crabwood predominating and often composing 80 per cent of the stand, on fresh-water marshes which are flooded at high tide; palm forests, with a few hardwoods, in the bayous and swamps back from the river banks; mixed forests, characterized by mora, along the rivers on lands which are above tidal influences but are more or less inundated during the rainy season. Both crabwood and mora forests are of great economic value. The average composition of the mora forests (in per cent of trees over 6 inches in diameter) is:

	Per cent
Mora	29.5
Trysil, or koro-balli	9.9
Kakeralli	6.3
Crabwood, wallaba, haiari-balli, and corkwood	15.3
16 other common species	21.4
78 miscellaneous species	17.6

In some places mora covers fairly extensive areas with almost pure stands.

Forests of the better drained lands vary widely in composition, but are generally characterized by the predominance of kakeralli or closely related species (*Lecythis* spp.). The mixed forests of the uplands of the northern portion of the colony have the following average composition:

	Per cent
Kakeralli (various species)	26.4
Kauta-balli	10.0
Kairi-balli	9.6
Haiari-balli	6.6
Baramalli	5.0
Trysil or koro-balli	4.0
Mora	3.0
Kabukalli, aramatta, and kurukai	5.5
Others	29.9

There are about 145 trees per acre over 6 inches in diameter, and the average diameter is about 12 inches. Trees have been measured with diameters over 8 feet, and some reach more than 200 feet in height. Average heights are from 60 to 70 feet on the coastal lowlands, about 100 feet on the interior lowlands, and considerably taller on the uplands. In the upland forests there are many small areas characterized by the occurrence of especially valuable species, such as greenheart, wallaba, and balata.

Greenheart composes 21.2 per cent of the trees over 6 inches in diameter in the "greenheart forest", and its principal associates are kakeralli, wallaba, kauta, trysil, morabukea, kairaballi, ariwiwa, and silverballi. There are 150 trees per acre in this type, averaging about 13 inches in diameter, while greenheart averages nearly 24 inches, and occasionally reaches 5 feet. Greenheart forests are almost entirely confined to the central part of British Guiana, on the Berbice, Demerara, and Essequibo rivers. Much of the most accessible forests has been cut over, but as only the larger greenheart trees are cut, the supply does not become exhausted. There are still extensive virgin areas back from the rivers.

Wallaba forests are mostly in the central and eastern parts of the colony, and the most accessible stands have been cut over several times within a century. The growth is rapid, so that merchantable size is reached in about 30 years. These forests contain about 170 trees per acre over 6 inches in diameter, and average about 14 inches in the second-growth stands. Wallaba, of two or more species, composes about 43 per cent of the stand, and the associated species are those common to the mixed forest type, except that greenheart is absent.

Balata trees are widely scattered through the forests, averaging less than one per acre in swampy districts, and from two to three per acre in the hilly country. In some places, however, they occur in groups of thirty or more, known as "balata reefs," and occasionally average as many as 26 trees per acre. Balata grows very slowly, requiring 70 years to reach a diameter of 15 inches.

In the less accessible interior districts, the composition of the forests

is similar to that of the northern hilly region. Mora is common along the river bottoms, and greenheart occurs on higher lands in the central portion of the colony. Other common species include kakeralli, kauta, wallaba, and balata. Cedar (cedrela) also occurs in this and the other regions.

Ownership of the Forests.—Only 1,800 square miles of British Guiana territory has been granted to private owners, and half of this area is forested. The remaining 76,880 square miles, or nearly 99 per cent of the forest, belongs to the crown. In 1920, 575 square miles of the crown land was under license for wood-cutting, for terms of from 1 to 5 years. It is the policy not to sell lands having trees suitable for timber or for producing rubber or balata.

Annual Growth, Annual Cut, and Losses.—Potential growth is enormous, but as a very small portion of the forest area is exploited, actual growth only balances the amount lost by cutting, decay, and fires. Periods of drought occur about once every ten years, at which times forest fires are numerous and destructive in the upland forests. The trees killed by fire are usually replaced within a comparatively short time by softwood species of rapid growth but of inferior value for lumber.

The average annual cut from crown forests during the period 1916-1919 (1915-1919 for greenheart and crabwood) is given in Table 327.

TABLE 327.—AVERAGE ANNUAL TIMBER CUT, BRITISH GUIANA

Kind of product	Quantity
Greenheart timber	558,982 cu. ft.
British Guiana mahogany (crabwood)	53,030 cu. ft.
Greenheart and mora (cut by Indians)	6,338 cu. ft.
Other hardwoods	73,664 cu. ft.
All other timber	34,205 cu. ft.
Total timber	726,219 cu. ft.
Fuelwood	78,560 tons
Charcoal	4,556½ tons
Wallaba shingles	5,686,145 pieces
Wallaba staves	202,468 pieces
Wallaba and other posts	350,752 lin. ft.
Wattles and sticks	14,876 pieces

The last six items represent a total of approximately 3,894,000 cubic feet of wood, making the total cut 4,620,000 cubic feet. No data are

available as to the amount of timber cut from private lands, but it is not believed to be very great.

Exports and Imports.—Greenheart and other timbers have been exported from British Guiana for more than 100 years. Table 328 shows the average exports for the 5-year periods ended 1914 and 1919.

TABLE 328.—EXPORTS OF TIMBER, BRITISH GUIANA.

Kind of product	Average of 5 years ending 1914	Average of 5 years ending 1919
Greenheart logs and lumber (cu. ft.)	291,874	99,605
Other species logs and lumber (cu. ft.)	26,766	23,072
Wallaba shingles—M shingles	2,395	2,780
Fuelwood—tons	9,538	8,137
Charcoal—tons	3,845	2,658
Total cu. ft. (about)	1,474,160	1,000,230

The United Kingdom has taken the greater portion of the greenheart, except in 1919, when the Netherlands took about half and the British West Indies most of the remainder. Most of the other timber exported has

TABLE 329.—DISTRIBUTION OF TIMBER EXPORTS

Country	Average for 5 years ending 1914	Average for 5 years ending 1919
	Per cent	*Per cent*
Greenheart logs and lumber:		
United Kingdom	69.6	46.1
Netherlands	12.2	20.2
United States	10.9	3.9
British West Indies	5.0	21.5
Canada	0.5	8.3
Other countries	1.8	
Other logs and lumber:		
United Kingdom	29.8	14.8
United States	25.4	1.2
British West Indies	6.9	71.5
Canada	20.3	12.5
Other countries	17.6	

gone to the British and other West Indies, with considerable amounts to Canada in some years. Firewood, shingles, and charcoal go almost entirely to the other Guianas and to the West Indies. In 1915 and 1916, small amounts of greenheart (15,634 cubic feet altogether) were exported to Panama for use in the Canal. The destinations of timber exports in percentages of the totals are shown in Table 329.

"Other countries" include Dutch and French Guiana, Dutch, French, and Danish West Indies, Porto Rico, Venezuela, Newfoundland, Denmark, and Germany.

Imports of lumber are almost entirely of white and yellow pine, used for building, 97 per cent of which is imported in the rough and dressed in the colony. Imports of oak staves and heading for rum barrels are almost equal in value to lumber imports, the total average value for each class of product being approximately $200,000 a year since 1914. The quantity of imports has been as follows:

Kind of product	Average for 5 years ending 1914	Average for 5 years ending 1919
Dressed pine lumber (cu. ft.)	11,887	9,213
Rough pine lumber (cu. ft.)	296,883	328,508
White oak staves, heading, and shooks (value)	$87,000	$197,500

The United States furnished 78.3 per cent of the timber previous to 1913, but in that year a preferential tariff agreement between British Guiana and Canada resulted in the transfer of much of the business to Canada, which has supplied 62.4 per cent of the pine imported since 1913, while the United States has supplied only 35.6 per cent. Almost all of the staves, headings, and shooks come from the United States, with very small amounts from Canada, England, and the British West Indies.

Domestic Consumption.—Native woods have been used altogether for most purposes except buildings and rum barrels, and are gradually replacing foreign woods for these purposes. As in most of the tropical American countries, the greatest volume of wood is used for fuel. The net average consumption is about as follows:

	Cu. ft.
Lumber and timber	941,260
Firewood and charcoal	2,876,940
Shingles, staves, posts, etc.	450,000
Total	4,268,000

This is equivalent to 13.7 cubic feet per capita.

Lumber and Wood-Using Industries.—Exploitation of most of the forests of the colony is impossible until transportation facilities are developed. The more accessible forests, on the other hand, have already been cut over repeatedly, though in such a way as not to destroy them. Logging is done by hand or with oxen, and very recently by motor tractors, and most of the timber is taken out to the coast by way of the rivers. In 1920, about 150 individuals and companies were operating in the crown forests, including timber licenses, and shingle, stave, and firewood cutters. There were 22 privately owned sawmills, some operated by water and some by steam, and one government water-power mill. Some sawing is also done by hand. The cutting of fuel-wood, charcoal burning, and shingle-making, both for domestic consumption and for export, are important industries. Manufactures of wooden products are not important, being limited chiefly to articles of local consumption, such as furniture, vehicles, and cooperage. The total number of persons employed on licensed wood-cutting grants averaged about 3,000 during the period 1915-1919, and about 2,600 were engaged in gathering balata.

Forestry Movement and Legislation.—The Crown Lands Ordinance of 1903 and subsequent regulations provide for the leasing or licensing of crown lands for the exploitation of timber and other products. Licenses are for short periods, usually a year, but are renewable. A small sum per acre is charged for the license, with additional sums as royalties on the products removed. Ordinarily, no trees are to be cut that will square less than 10 inches, except wallaba or similar trees cut for posts, beams, and other small products, and rubber or balata trees may be cut only upon written permission of the Department. In case of license for collecting balata, the size of trees that may be tapped and the method of tapping are specified. No attempts have yet been made to control forest fires, or to plant waste lands.

The Forestry Branch of the Department of Lands and Mines originated in 1908, and a technically trained forester and several forest rangers were appointed in 1910. The principal duties of the forestry office are to explore and survey the forests of the colony, and to study the possibilities of developing them. The rangers serve as patrolmen to prevent depredations on crown lands and to check up the licensed operations. No control is exercised over the small area of forest land in private ownership.

The income of the Forestry Branch during the four years 1916-1919 averaged approximately $67,500, and the expenditure about $10,000, making the net income $57,500, or 15.6 cents per acre for the 575 square miles under exploitation.

Secondary Forest Products.—The balata-collecting industry is one of the most important industries of British Guiana. Balata gum was

first exported in 1859, and in 1865 over 20,000 pounds was exported. In 1888 exports reached 250,000 pounds, and in 1917 nearly 1,600,000 pounds, valued at almost $1,000,000. Since 1890 the average annual export, by five-year periods, has been:

	Lbs.
1890–1894	199,103
1895–1899	336,453
1900–1904	477,331
1905–1909	655,737
1910–1914	1,068,179
1915–1919	1,429,961

From 67 to 97 per cent, averaging about 85 per cent, goes to the United Kingdom, and most of the rest to the United States. Balata trees (*Mimusops globosa* or *M. elata*) are widely scattered through the forests, occasionally forming small groups, or "reefs." A very large proportion of the accessible forests have been licensed for the collection of balata. The average yield per tree is about 5 pounds.

Rubber is produced in small quantity from a wild native species, *Sapium jenmani*, and about 5,000 acres has been planted with *Hevea*. The average exports amounted to 1,500 pounds from 1910 to 1914, and 14,700 pounds from 1915 to 1918, being nearly 24,000 pounds in 1918.

Gums include locust gum, used in varnish, which is produced by the locust tree (*Hymenaea courbaril*); haiawa gum, used as incense (from *Protium heptaphyllum*); chicle (from an unidentified tree belonging to the *Sapotaceae*); and copaiba balsam, from *Copaifera guianensis*. Exports of gums averaged 3,052 pounds from 1910 to 1914, and 726 pounds from 1915 to 1919.

Oils are produced from the fruit of crabwood (crab oil), and from the kokerit palm (*Maximiliana regia*) and several other palms. The nuts of sawarri (*Caryocar tomentosum*) are of considerable food value, and are extensively used locally.

Tanbark is obtained from mangrove, mora, and greenheart, especially mangrove. The total production during the period 1916-1919 averaged 83,335 pounds a year, and very small amounts have been exported. While the supply of mangrove is large, it is comparatively unexploited.

The Probable Future.—Of the nearly 300 species of trees known to occur in British Guiana, about 40 are sufficiently abundant and of such qualities that they will eventually be exported in some quantity, although only a dozen or so are now known on the general market. Eighty-five of the more common species have been classified according to hardness, as follows:

	Species
Excessively hard (like lignum vitae or ebony)	3
Extremely hard (like boxwood or eucalypts)	18
Very hard (like persimmon)	11
Hard (like yew)	13
Rather hard (like ash or elm)	4
Firm (like beech, oak, or chestnut)	12
Soft (like birch, alder, or pine)	19
Very soft (like white pine, redwood, or poplar)	5

There are reported to be abundant supplies of soft woods suitable for making paper pulp.

The chief obstacles to extensive development of the forest resources are the lack of transportation, the comparatively sparse population, the still more or less primitive methods of manufacture and utilization, and the unfamiliarity of consumers with the qualities of the Guiana woods. All of these can be overcome, and when they are, the colony may be expected to become an important source of timber for the general market, supplying not only furniture and cabinet woods, but also considerable quantities of moderately hard timber for construction, flooring, shingles, ties, and various industrial uses. Under management, there will be a tendency toward the development of stands composed of one or a few species of greatest economic value, and this will increase the productivity of the forests and at the same time reduce cost of exploitation.

Trees of British Guiana.—Among the more important kinds of timber are the following:

TABLE 330.—PRINCIPAL TREES, BRITISH GUIANA

Aramatta (*Diplotropis brachypetalum*) has greenish or brownish figured wood, used for furniture, boats, and houses. Fairly large, and weighs 50 pounds per cubic foot.

Arisauro (*Batairea guianensis*) has yellow or brown, coarse-grained, soft wood, used for decorative work and furniture. It is large, weighs from 44 to 47 pounds per cubic foot, and is durable and insect-resistant.

Balata, bullet-tree, or koberu (*Mimusops globosa*) has very hard, durable wood, excellent for posts, buildings, spokes, staves, and shingles. Being more valuable for its gum, it is seldom cut.

Balata-balli, barata-balli, or barta-balli (*Lucuma mammosa* or *L. bonplandii*) resembles balata, and is a good wood for building, interior finish, and furniture.

Cedar or kurana (*Cedrela odorata* or a closely related species) is reddish brown, fairly coarse-grained, soft, and durable. It weighs from 24 to 35 pounds per cubic foot, and reaches large sizes. Used for furniture, coffins, cigar boxes, interior finish, and construction.

Crabwood or British Guiana mahogany (*Carapa guianensis*) resembles mahogany in color and texture. It is moderately soft, weighs from 38 to 46 pounds per cubic foot, and is the most widely used native furniture and construction wood. It is also very generally used for ship and boat building. The supply is large.

Dalli (*Myristica*—or *Virola*—*surinamensis*) has grayish, coarse-grained, soft wood, and

TABLE 330.—PRINCIPAL TREES, BRITISH GUIANA—*Continued*

is used for match boxes, coffins, and interior work. It weighs 29 pounds per cubic foot. The seeds contain 60 per cent of a fat used in making soap and candles.

Determa (*Nectandra* sp.) resembles cedar, and weighs from 35 to 37 pounds per cubic foot. It is much used for masts and spars, some of which are 90 feet long and 14 inches in diameter at the top. Being light and strong, it is used for planking boats and railroad cars.

Duka (*Tapirira guianensis*) resembles inferior mahogany, is fairly large, weighs 35 pounds per cubic foot, and is used for interior work.

Dukalli-balli or dukala-balli is dark brown or purplish, heavy (48 to 56 pounds per cubic foot), durable, and is used for furniture and cabinet work. It is a large tree.

Euriballi, yuraballi, or huraballi, has handsome, close-grained, reddish brown wood resembling mahogany, and is excellent for furniture and boat planking. It weighs from 49 to 53 pounds per cubic foot.

Fotui, futui, or phootee (*Jacaranda copaia*) has very soft, coarse-grained wood somewhat resembling white pine. It weighs from 20 to 27 pounds per cubic foot, and is used for rough lumber and matchboxes.

Greenheart or bibiru (*Nectandra rodiei*) is perhaps the best known tree of British Guiana. Its wood varies in color from yellowish brown to dark brown, is straight grained, free from knots, very durable in soil or water, and strong. It resists termites and teredo, and is extensively used for ship-building, docks, piles, bridges, carriage shafts, and general construction. Logs can be cut 70 feet long and 24 inches or more square, but most of the timber produced now is smaller, because of difficulty of getting out large logs. Weighs from 58 to 75 pounds per cubic foot.

Hackia or ironwood (*Tabebuia, Tecoma, or Siderodendron* sp.) has brown, close-grained, extremely hard, and heavy wood (81 pounds per cubic foot). It is a good substitute for lignum vitae, and is used for cogs, shafts, walking sticks, and hammer and sledge handles. It is a fairly large tree.

Haiawa-balli or zebrawood (*Connarus guianensis* or *Omphalobium lambertii*) is a fairly large tree, whose wood is suitable as a substitute for mahogany in furniture and cabinet work.

Hubu-balli or houboo-balli (*Mimosa guianensis*) has figured brown wood, weighing about 40 pounds per cubic foot, durable in water, and used for boat building, furniture, and cabinet work.

Itc-balli, eta-balli, or aeta-balli (*Vochysia tetraphylla*) has pinkish, fairly soft wood, weighing about 48 pounds per cubic foot, and durable in salt water. It is used for furniture.

Itiki-boura-balli or tigerwood (*Machaerium schomburgkii*) has deep brown, almost black, close-grained wood, resembling walnut. It reaches fairly large size, and is used for cabinet work, paneling, and furniture. Weighs about 50 pounds per cubic foot.

Kabukalli (*Goupia glabra*) reaches large size, and has reddish brown, close-grained wood, weighing from 53 to 56 pounds per cubic foot. It is used for furniture, building, railroad ties, boats, and paving.

Kakeralli (*Lecythis* spp.) are among the most abundant trees in the colony. The wood is fine-grained, brownish in color, straight-grained, and very strong and hard. It weighs from 53 to 62 pounds per cubic foot. It is used for construction, wharves, piles, and mine timbers. It is said to resist teredo attacks.

Keriti, kretti, or keriti silverballi (*Nectandra pichurim*) has fairly soft, brown, coarse-grained wood, used for interior construction and boat planking. It weighs from 25 to 32 pounds per cubic foot.

Kurahara resembles an inferior mahogany, and is used for furniture and boat building.

TABLE 330.—PRINCIPAL TREES, BRITISH GUIANA—*Continued*

Letterwood, snakewood, or burokoro (*Brosimum aubletii*) has very hard, dark brown, beautifully marked wood, weighing from 77 to 83 pounds per cubic foot, and highly prized for inlaying, cabinet work, turnery, and canes. Tibicushi, or bastard letterwood, is a closely related species, of similar properties.

Locust, simiri, or courbaril (*Hymenaea courbaril*) has hard, dark brown or reddish, fine-grained wood, which is very strong and durable. It weighs from 33 to 57 pounds per cubic foot. Used for furniture, interior finish, ship planking, railway cars, general construction, and treenails. It yields a gum which is used in varnish.

Mora (*Dimorphandra mora* or *Mora excelsa*) furnishes one of the best known and most valuable woods of the colony. It is said to be more durable than teak, and is extensively used for shipbuilding, piles, ties, and paving, as well as for general construction. The wood is coarse-grained, dark reddish brown, and weighs from 57 to 68 pounds per cubic foot. The tree reaches good size and the supply of timber is large.

Purpleheart or koruburelli (*Copaifera pubiflora*) has brown wood which becomes purple after cutting. It is very hard, strong, and rather heavy, weighing from 49 to 62 pounds per cubic foot. Used for furniture, cabinet work, and construction. Another purpleheart, or saka (*Peltogyne paniculata*), is similar in appearance and uses.

Silverballi or ciruaballi includes several trees of the laurel family. The wood of the white silverballi weighs about 26 pounds per cubic foot and is used for interior work. Brown silverballi (*Nectandra* sp.) weighs from 44 to 57 pounds per cubic foot, is dark brown, and is used for furniture and boat building. Yellow silverballi (*Nectandra pisi*) weighs from 37 to 52 pounds per cubic foot, is yellow or brownish, and makes fine furniture and boat planking.

Simarupa (*Simaruba amara* or *S. officinalis*) has very soft, coarse-grained, white wood, weighing from 27 to 30 pounds per cubic foot, and resistant to termites. It is a large tree, used for partitions and interior work, and for matches.

Suradanni or seridani (*Hieronyma laxiflora* or *H. alchorneoides*) has reddish brown, coarse-grained wood resembling mahogany. It weighs from 45 to 47 pounds per cubic foot. Used for furniture, boats, canoes, and ties.

Tatabo or sicopera (possibly *Bowdichia* sp.) is a fairly large tree, the wood of which may be substituted for walnut in furniture. It is used for construction.

Tauroniro, tawonero, or umiri (*Humiria floribunda*) has dark reddish brown, fine grained, strong, hard wood, weighing from 48 to 74 pounds per cubic foot (average 62 pounds). Used for house frames, furniture, and spokes.

Tonka bean or kumara (*Dipteryx odorata*) has very hard wood used for cogs, shafts, mill-beds, and paving. The fruit is used in making perfumery.

Trysil or koroballi (*Pentaclethra filamentosa*) is used for furniture, beams, and framing.

Ulu, olu, or ooloo (*Trattinickia rhoifolia*) has light brown wood with a satiny lustre. It is soft, weighs 31 pounds per cubic foot, and is suitable for inside boarding, shelves, furniture, and cigar boxes.

Vogelkop, fogelkop, or kudibutshi (*Sideroxylon* sp.) has light brown, close grained, fairly hard wood, which weighs 50 pounds per cubic foot, and is used for oars, paddles, and interior work.

Wadaduri or monkeypot (*Lecythis grandiflora*) has light red or orange colored, close-grained, very hard, strong, and stiff wood, which weighs from 53 to 74 pounds per cubic foot, and is used for building, furniture, turnery, spokes, and staves.

Wallaba includes several species of *Eperua*. The most abundant, soft wallaba (*E.*

TABLE 330.—PRINCIPAL TREES, BRITISH GUIANA—*Continued*

falcata) has coarse-grained, deep red wood, weighing from 62 to 67 pounds per cubic foot, but easy to split, straight grained, and very durable in exposed situations. It reaches large size, and is one of the most abundant and important trees of the colony. Very extensively used for shingles, staves, building, furniture, fenceposts, and fuel, and much is exported. Some wallaba paving has been laid in New York. Ituri wallaba (*E. jenmani*), is similar in appearance and uses, but less durable and less abundant.

Wamara, clubwood, or Brazilian ebony (*Swartzia tomentosa*) has close-grained, almost black wood, weighing from 64 to 67 pounds per cubic foot, very strong, and used for cabinet and inlay work and oars.

Warakuri or white cedar (*Tabebuia longipes*) furnishes the best wood in the colony for foundations. It is also used for oars and paddles. It is fairly soft and easy to work.

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CHILE

Extent of Forests.—The total forested area of Chile is 38,900,000 acres, or 21 per cent of the land surface. This is not all productive forest, however. Of the total, 9,000,000 acres has been so devastated by fire that it is useful merely for grazing, 18,700,000 acres produces firewood only, and 6,200,000 acres produces posts and scattered larger timber, which leaves only 5,000,000 acres of commercially valuable saw timber. The productive forest, including lands growing fuel wood, is therefore 29,900,000 acres, which is 16 per cent of the total area of the country, and 7.7 acres per capita.

The forest area has been reduced to a great degree since the days of the Incas, but more especially within the last 50 years, and it may

TABLE 331.—FOREST AREA, CHILE

Province	Brushland and cordwood (arbustos)	Sprout forests (retoños)	Young plantations	Saw timber (montes altos)	Total	Proportion of land area
	acres	*acres*	*acres*	*acres*	*acres*	*per cent*
Tacna	1,350	30	.....	.....	1,380	0.02
Tarapaca	2,645	75	.....	.....	2,720	.03
Antofagasta	1,060	20	5	.....	1,085	.01
Atacama	4,075	990	415	35	5,515	.03
Coquimbo	198,840	18,030	1,435	420	218,725	2.54
Aconcagua	153,750	19,250	1,010	990	175,000	4.98
Valparaiso	121,770	45,700	600	1,230	169,300	7.35
Santiago	191,130	46,930	1,560	1,480	241,100	6.65
O'Higgins	97,020	29,640	400	740	127,800	8.53
Colchagua	200,600	86,450	880	2,470	290,400	11.77
Curico	213,350	98,800	430	2,720	315,300	16.55
Talca	225,650	172,900	1,850	24,700	425,100	17.30
Linares	206,320	209,950	1,030	37,050	454,350	18.02
Maule	172,990	128,440	780	54,340	356,550	22.67
Nuble	177,700	247,000	2,100	98,800	525,600	24.12
Concepcion	107,300	88,920	3,030	74,100	273,350	13.14
Arauco	37,170	46,930	300	74,100	158,500	10.08
Bio-bio	155,460	296,400	1,340	494,000	947,200	28.23
Malleco	44,050	123,500	5,750	247,000	420,300	22.09
Cautin	95,130	98,800	3,810	209,960	407,700	10.93
Valdivia	25,292,600	4,441,200	270	3,675,865	2,301,700	40.00
Llanquihue			10		11,108,060	41.56
Chiloë			.....			
Magallanes			15		20,000,000	47,72
Total	27,699,960	6,199,955	27,020	5,000,000	38,926,935	21.00

be expected to shrink still further. Approximately 20,000,000 acres now covered with timber or young growth is believed to be ultimate agricultural land, and the future use of 7,500,000 acres more is uncertain at this time. About 11,400,000 acres is undoubted forest land. A very large part of it is now practically devastated.

The distribution of forests is exceedingly uneven, ranging from practically none in the northern provinces to more than 40 per cent of the area of the southern ones. Table 331 shows the approximate distribution by provinces, arranged in their order from north to south.

Character of the Forests.—Six forest regions may be distinguished in Chile, characterized by differences in climate and consequent differences in types of forest. They are:

1. The most northern region, including the provinces of Tacna, Tarapaca, and Antofagasta, has almost no woodland, and none at all that produces saw-timber. There are a few small areas of scrubby growth, valuable chiefly for fuel wood. The pods of tamarugo (*Prosopis tamarugo*) and algarrobo (*P. siliquastrum*), which contain from 35 to 50 per cent of tannin, are exported from this region. Another tree of some local importance is carbon (*Cordia decandra*), which is used in cabinet work and for making ornamental veneer.

2. The provinces of Atacama and Coquimbo also have very limited areas of forest, most of which is open, scrubby stands of short-boled trees usually from 8 to 15 feet tall, fit only for fuel wood. The most important trees are chañar (*Gourleia decorticans*), algarobillo (*Caesalpinia brevifolia*) and guayacan (*Porliera hygrometrica*). Another tree of the high mountains near the Bolivian frontier is queñoa (*Polylepis incana*), which is seldom more than 15 feet tall, but is utilized for fuel and building.

There are also dense stands of fray jorge (*Aextoxicum punctatum*) and other species on limited areas along the summits of the coastal ranges near the Limari River. These trees occasionally attain heights up to 25 feet, and have spreading crowns. They are valuable chiefly for protection forests.

3. The third region includes the provinces of Aconcagua, Valparaiso, Santiago, O'Higgins, Colchagua, Curico, and Talca. The percentage of woodland increases southward from 5 per cent in Aconcagua to 17 in Talca. In the four provinces first named the forests consist of more or less scrubby stands of evergreen hardwood species, such as:

Espino comun	*Acacia cavenia*
Belloto	*Bellota miersii*
Fray jorge	*Aextoxicum punctatum*
Quillai	*Quillaja saponaria*
Maiten	*Maytenus boaria*
Litre	*Litrea caustica*

Boldo	*Boldoa fragrans*
Peume	*Cryptocarya peumus*
Canelo	*Drimys winteri*
Algarrobo	*Prosopis siliquastrum*

The tallest trees are belloto and peume, species of *Lauraceae,* which occasionally reach heights of 100 to 130 feet. Trees of this height occur only in sheltered locations in valleys and canyon bottoms. On the slopes the trees are stunted and shrub-like. This condition holds for the coastal region as far south as Concepcion. Palms (*Jubaea spectabilis*) are more or less common southward from Valparaiso. In the three southern provinces other species appear, among them:

Roble de Colchagua	*Nothofagus macrocarpa*
Roble pellin	*Nothofagus obliqua*
Coihue	*Nothofagus dombeyi*
Avellano	*Guevina avellana*
Bollen	*Kageneckia* sp.
Cipres,	*Libocedrus chilensis*

Most of these species, except roble pellin, are evergreen. Some of the stands contain commercial quantities of saw-timber, amounting to as much as 6 per cent of the total forest area in Talca. The coastal forest extends to the southern edge of Curico (latitude 35° S.), while the Andes forests reach as far north as 34° S., the northern boundary of Colchagua. There are scattered bodies of timber farther north, but no continuous forests.

4. Real commercial forests begin to appear in the fourth region, which embraces the provinces Linares, Maule, Nuble, Concepcion, Arauco, Bio-bio, Malleco, Cautin, and most of Valdivia. A great deal of the original forest within this region, especially that part of it north of the River Bio-bio, has been cleared for agriculture or for its wood, or burned to make room for grazing. Of the total wooded area, from 8 to 40 per cent is saw-timber forest in the northern provinces, and 50 per cent or more south of the Bio-bio. The commercial timber is principally at the lower altitudes or in sheltered locations higher up. In the northern part of the region, especially, all the more accessible forest has been destroyed and what is left is back in the mountains. Extensive stretches of higher country, which from a distance appear to be densely forested, are really covered with chaparral-like brush, from 1 to 10 feet high. From here southward the forests are composed of a mixture of evergreen and deciduous hardwoods and conifers. In the northern part of the region, the most important species are:

Fray jorge	Espino comun
Quillai	Maiten
Litre	Boldo
Peume	Canelo

Roble pellin
Avellano
Lingue (*Persea lingue*)
Arrayan (*Eugenia, or Myrceugenia, apiculata*)
Coihue
Ulmo, or muermo (*Eucryphia cordifolia*)
Maqui (*Aristotelia maqui*)

The first continuous forests begin south of the river Maule. In this region trees occasionally reach heights of from 60 to 100 feet. South of the Bio-bio the forest is more in a continuous body. Here espino and quillai drop out, and the following additional species become numerous:

Radal (*Lomatia dentata* or *L. obliqua*)
Mañiu or lleque (*Podocarpus andina*)
Araucaria or piñon (*Araucaria imbricata*)
Cipres de Gaitecas (*Libocedrus tetragona*)
Rauli (*Nothofagus procera*)
Laurel (*Laurelia aromatica*)
Luma (*Myrtus* or *Myrceugenia luma*)
Temu (*Eugenia* or *Myrceugenia temu*)
Pitra (*Myrceugenia pitra* or *M. multiflora*)
Nire (*Nothofagus pumilio*)

In the mountains east of Valdivia also occur:

Alerce (*Fitzroya patagonica*)
Manui (*Saxegothea conspicua*)
Mañiu (*Podocarpus nubigena*)
Laurel or huahuan (*Laurelia serrata*)
Teñiu (*Weinmannia trichosperma*)
Tiaca (*Caldcluvia paniculata*)
Maiten (*Maytenus magellanica*)

Alerce occurs chiefly in swamps, where it reaches large size. Cipres, or cedro, is fairly common in the mountains and also in some localities in the lowlands. In some places it forms open pure stands. Abundant both in this region and in that to the south is quila (*Chusquea quila*), a bamboo used for cattle fodder. The composition of forests in the region from Bio-bio to Valdivia is approximately as follows:

	Per cent		*Per cent*
Coihue	30 to 38	Mañiu	3 to 5
Roble	17 to 20	Radal	3 to 5
Laurel	8 to 15	Cipres	1 to 4
Rauli	5 to 10	Luma	1 to 3
Lingue	4 to 10	Alerce	0 to 1
Canelo	4 to 8	Miscellaneous	2 to 11
Ulmo	2 to 7		

Mature trees reach large sizes, diameters ranging from an average of 2 feet for lingue to 3 feet or more for rauli, roble, and laurel, and up to 5 feet for coihue, while clear lengths of bole range between 30 and 70 feet and total heights between 100 and 160 feet. On an average, mature trees of the commercially important hardwood species will saw

out about 24 cubic feet (288 board feet) of lumber. It has been estimated that there are approximately 80 trees per acre in the virgin forests, making 1,920 cubic feet of lumber (or about 23,000 board feet) per acre. This estimate evidently makes no deduction for defective trees. If from 80 to 40 per cent be deducted for defect, as should be done, the stand will amount to from 5,000 to 15,000 board feet. Merchantable rauli, lingue, and laurel occur only at comparatively low altitudes, roble extends a little higher, and coihue still farther up, while for a considerable distance beyond the upper limits of merchantable timber there are dense stands of shrub-like ñire and leda.

In the mountains of Nahuelbuta, between Arauco and Malleco provinces, are forests of *Araucaria,* extending from 3,000 feet to 5,000 feet altitude. The stands are open, with trees from 100 to 165 feet tall. In mixture with it there are more or less roble, coihue, rauli, mañiu, and other species. Along the Andes, in the provinces of Malleco, Bio-bio, and Cautin, and extending across into Argentina, is the main body of "pine" or *Araucaria.* The trees frequently attain diameters of 4 feet or more, with boles clear of limbs for 70 feet and heights of 145 feet; average mature trees, however, are about 32 inches in diameter, with from 50 to 60 feet of merchantable length and a total volume of approximately 250 board feet per tree. Stands in many places are very heavy, with from 40 to 200 merchantable trees, containing 10,000 cubic feet or more (50,000 board feet) per acre, but more commonly they are rather open, with fewer trees and considerably less volume. At the higher altitudes, where other species do not extend except in stunted, shrubby form, *Araucaria* forms extensive pure stands. Toward its upper limit it, too, is stunted, being only from 15 to 30 feet tall and of no commercial value except for its seeds (piñones), which form an important part of the diet of the native Indians.

5. The fifth region contains the great bulk of the remaining merchantable saw-timber in Chile. It embraces the provinces Llanquihue, Chiloe, and southern Valdivia. *Araucaria* does not occur in the region, and roble pellin, laurel, rauli, coihue, mañiu, and lingue occur only in the northern part. A number of new species appear, among them being:

Ciruelillo (*Embothrium coccineum*)
Pelu (*Sophora tetraptera*)
Meli (*Myrtus* or *Myrceugenia meli*)
Peta (*Myrceugenia planipes*)
Tepu (*Tepualia stipularis*)
Roble de Chiloe (*Nothofagus nitida*)
Roble de Magallanes (*N. betuloides* and *N. antarctica*)
Mañiu del sur (*Podocarpus chilina*)
Huinque (*Lomatia ferruginea*)
Canelo (*Drimys chilensis*)

In Llanquihue the forests are composed about as follows:

	Per cent		Per cent
Coihue	30	Alerce	5
Roble	16	Mañiu	5
Cipres	10	Canelo	3
Laurel	8	Radal	3
Ulmo	6	Miscellaneous	14
Luma	6		

There was formerly an extensive "alerzal," or forest of alerce, between Lake Llanquihue and Puerto Montt, but it has mostly been cut for lumber and little of the better class of timber remains. The stands were in many places almost pure alerce, and in other places mixtures of alerce with canelo, avellano, ciruelillo, tepu, and others. The best remaining stands of alerce are along the coast ranges of Valdivia and Llanquihue, the western mountains of Chiloe, and the canyons and mountains of eastern Llanquihue. The most important stands of cipres are in the 350-mile stretch from the island of Chiloe to the Taitao peninsula.

From Chiloe southward, both on the islands and on the mainland, the predominant species is coihue, with occasional groups of cipres. While south of Gaitecas Island at lower elevations coihue gives place to *Nothofagus betuloides*, it remains the predominant tree higher up. Other common trees are huinque, laurel, teniu, maniu, cipres, and tepu. At the higher altitudes deciduous species of *Nothofagus, N. pumilo* (ñire) and *N. antarctica*, take the place of the evergreens found lower down. In this region there are still extensive stands of virgin timber, much of which runs 9 or 10 thousand board feet to the acre for thousands of acres. The species of greatest commercial value are the conifers alerce and cipres, and ulmo, a hardwood. These furnish the best general-purpose lumber of Chile. On an area of 250,000 acres in Llanquihue, the stand of saw-timber, estimated to average 10 thousand board feet per acre, is composed of roble (all species of *Nothofagus*) 50 per cent, laurel 15 per cent, ulmo 10 per cent, and others 25 per cent. This timber runs from 6 to 8 logs per 1,000 board feet. It is estimated that only 20 to 60 per cent of the total volume of virgin hardwood stands in this region is merchantable, because of the great amount of decay in the larger trees. Much of the swamp land in the region is either too wet to produce saw-timber of good quality or has been culled of its best material, so that while it bears a dense cover of small trees of coihue, lingue, canelo, arrayan, avellano, radal, luma, and other species, little is merchantable except for fence posts and fuel.

The total stand of timber on the 2,875,000 acres of virgin forest still remaining in the provinces south from the River Bio-bio, including

Llanquihue, has been estimated as follows, apparently without allowance for defective material:

	Cu. ft. of sawed lumber
Lingue	315,740,000
Rauli	352,970,000
Cipres	455,232,000
Laurela	694,630,000
Roble	1,360,042,000
Coihue	1,472,201,000
Others	6,315,443,000
Total	10,966,258,000

If this figure be reduced from 40 to 80 per cent to allow for defects, the stand will be between 2.2 billion and 6.6 billion cubic feet (or between 26 and 79 billion board feet).

6. The Territory of Magallanes is the sixth region. This large territory, more than 65,000 square miles in area, is practically uninhabited, having but 30,000 inhabitants, more than half of whom are in the city of Punta Arenas. It is extremely rough and cut up by innumerable channels and fiords. Although the forested area is large, covering nearly half of the Territory, a comparatively small part of it is commercially valuable for saw-timber. The trees gradually become smaller and more stunted toward the south, until at the Straits of Magellan much of the forest is little more than a chaparral formation, although it is important as a source of fuelwood and there are some stands of large timber in sheltered spots. The species are about the same as those in the southern part of the region on the north, except that roble de Chiloe and radal drop out, and the others gradually diminish in size and drop out also toward the south until only roble de magallanes, maiten, meli, and petu remain, and they are shrubs rather than trees. At the Straits, the principal species are roble (*Nothojagus betuloides*), canelo (*Drimys winteri*), and some cipres (*Libocedrus tetragona*), with scrubby *Nothofagus antarctica* at the higher altitudes.

Island Possessions.—The archipelagoes San Ambrosio and San Felix, situated several hundred miles off the coast of Atacama, and the islands Salas y Gomez, 2,000 miles farther west, are practically barren and have no tree growth. Easter Island, in the South Pacific, also has practically no timber. On the other hand, the islands of Juan Fernandez, which are some four hundred miles west of Valparaiso, have forests covering about half their area. One of these islands was for several years the abode of Alexander Selkirk, whose story is supposed to have been the basis for "Robinson Crusoe." There are three principal islands, Masatierra, Santa Clara, and Masafuera, the last named culminating in a peak 5,900 feet above sea level. The forests, which are in the valleys

and near the shores, are subtropical in character and composed principally of evergreen species, some of which attain diameters of 6 feet and heights of 100 feet.

Ownership of Forests.—No complete figures as to ownership of Chilean forests are available. The state owns practically all the forests in the Andes and the Territory of Magallanes and a large part of those in the other provinces. North of the Bio-bio most of the forest land has passed into private ownership, as has some of that to the south, and concessions have been given for timber cutting on public forests in many places. Up to 1914, the state had definitely set apart 1,600,000 acres in 8 reserves, and was planning to extend the system, both by reserving areas already owned and by acquiring privately owned areas within the public forests, or other lands especially needed for protection of watersheds and for similar public purposes.

Annual Growth.—Practically no data are available regarding the annual increment in Chilean forests, as is natural in a country which has not yet gone beyond the stage of "timber mining." It is probable that the great amount of decay in the virgin stands fully offsets any growth that may be taking place in those or in younger stands, so that the net growth is nil. Most of the trees native to Chile grow very slowly, while exceedingly rapid growth has been attained by several exotic species which have been planted to a considerable extent in the central part of the country. *Araucaria* is reported to reach maturity in from 150 to 300 years, and the hardwood species probably do not grow much faster.

Annual Cut.—Data regarding the annual cut from Chilean forests are more or less fragmentary and somewhat conflicting. The operations while numerous are practically all small, and no systematic statistics have ever been collected. Some writers put the lumber cut at as low as 36,500,000 board feet, not including rough products such as ties, poles, posts, cooperage, etc. It is likely, however, that this figure represents only a small part of the cut—perhaps only that portion which reaches the general market in the larger cities. A very large proportion of the lumber is cut by small portable mills in clearing estates, and is sold and used locally. An important source of low-grade lumber, box shooks, and match blocks is planted alamo (*Populus pyramidalis*). The most complete estimate, based on statistics of consumption, prepared by an official of the Chilean Forest Service, is as follows:

	Cu. ft.
Lumber and timber	45,700,000 (548,000,000 board feet)
Fuelwood	508,320,000 (635,400,000 cubic feet stacked)
Charcoal	130,000,000 (wood equivalent of 600,000 metric tons)
Total	684,020,000

This amounts to 22.9 cubic feet per acre of forest, or 177 cubic feet per capita. The cut of lumber and timber by species is approximately the following:

	Cu. ft.
Roble	6,900,000
Rauli	5,900,000
Coihue	5,300,000
Laurel	4,150,000
Lingue	3,550,000
Cipres	2,350,000
Alamo	15,750,000
Others	1,800,000

Loss by Fires and Other Agencies.—The practice of burning over forest lands to make pasturage has prevailed for centuries in the northern and central provinces, and is the principal cause for the almost total disappearance of the original forests of those regions. In the regions where clearing of land for agricultural use is still going on, it is a common practice to burn the slashing broadcast and let the fire run until it stops. This, of course, gradually eats into the remaining green timber and results in the devastation of large areas not yet needed for farming. Forest fires burn over large areas every year except in the limited region inhabited by the native Araucanians, who are very careful to keep fires from the pine forests on which they depend during certain seasons for much of their food.

Loss by decay in the virgin forests of southern Chile is very great. No figures on the amount of this loss are available.

Exports and Imports.—Although her own forests could furnish sufficient material to fill domestic requirements, Chile is a wood-importing country. This is due principally to geographical factors. Most of the population and wood-consuming industries are in the almost treeless northern and central provinces, which find it as easy to import lumber by sea from the west coast of North America as to get it from the southern provinces of Chile, where transportation facilities are rather poor and costs of exploitation high.

Lumber and beams of alerce were exported from Chile to Peru even before the Spanish Conquest, but the supply of accessible timber of this species is so far depleted that it can no longer begin to supply domestic requirements. Small quantities of lumber are exported to Argentina and occasionally to Bolivia. In 1915, the value of woods exported was $140,000 (U. S. gold), of which Argentina took lumber and various wooden products to the value of $85,000 and Bolivia most of the rest, chiefly in the form of roble railroad ties. This represented a considerable increase in lumber export, and a decrease in shipments of ties. The total volume was probably under 400,000 cubic feet. In 1920, 253,000

board feet of timber, mostly in the log, was exported to the United States.

Imports of lumber come chiefly from the United States, with some from Canada and small quantities from Europe and Japan. The only South American woods imported are bamboo from Ecuador (cañas de Guayaquil), used for lath and roofing, and small quantities of fuelwood for local consumption along parts of the Bolivian frontier. Douglas fir makes up the greater part of the imported lumber, with an average volume of 3,720,000 cubic feet out of a total of 3,875,000 imported during the period 1912-1914. Small quantities of other woods are brought in, including southern yellow pine ("pino amarillo"), white and sugar pines ("pino blanco"), redwood ("pino colorado"), Scotch pine from the Baltic region, which is used principally in extreme southern Chile, and various hardwoods, such as American, Hungarian, and Japanese oaks, ash, yellow poplar, walnut, birch, cherry, and mahogany. The wine industry is an important one in Chile and requires large quantities of tight staves for containers. Rauli is very generally used for this purpose, but 78,000 cubic feet of American white oak staves were imported in 1911, which was a 100 per cent increase in 10 years. Small quantities of lath, molding, matches, box shooks, and other products are imported, amounting in 1911 to about 200,000 cubic feet. The total wood imports amount to a little more than 4,000,000 cubic feet.

Efforts have been made to develop the domestic industry so as to eliminate, as far as possible, the importation of wood, which doubled in volume and tripled in value from 1900 to 1911. A decree of April 19, 1899, provided that the railroads wherever possible should use ties made from native woods in preference to those of Douglas fir. The tariff on wooden furniture is so high that very little is brought in, and even much of that sold in Chile as "imported" is said to be of domestic manufacture. In May, 1916, the duty on rough lumber was raised from the equivalent of about $6 (U. S. gold) per 1,000 board feet to about $10, and in February, 1921, it was again increased to $15. Whether or not this will have an appreciable permanent effect on the volume of lumber imports cannot be told until conditions return more nearly to normal. Imports did decline to a very noticeable extent during and immediately after the war. In 1913 imports of construction lumber amounted to 58,436,000 board feet (or 4,870,000 cubic feet), not including other products—or, according to another authority, 49,986,000 board feet. In 1918 only 31,469,000 board feet (2,622,000 cubic feet), and in 1919 only 10,930,000 board feet (911,000 cubic feet) were imported.

Domestic Consumption.—The domestic consumption of wood is almost the same as the quantities given above in the discussion of the cut. Adding imports of 4,000,000 cubic feet and subtracting exports of

400,000 cubic feet, the amount consumed within the country is 687,620,000 cubic feet, or 178 cubic feet per capita. Consumption of lumber and timber, including box boards, cooperage, railroad ties, poles, piling, and other larger material as well as construction material, amounts to 49,300,000 cubic feet, or 591,600,000 board feet—13 cubic feet or 153 board feet per capita.

The largest consumers of imported lumber are the nitrate, coal, and copper mining companies and the 4,000 miles of railroad. They also consume large quantities of domestic lumber, as do the building and wood-using industries. The consumption of wood for fuel is many times greater than that for all other purposes combined.

The Lumber and Wood-Using Industries.—The lumber industry ranks third in importance in Chile, being surpassed only by mining and agriculture. As a manufacturing industry, it is probably first in number of establishments and workers employed and second in capital invested. It is concentrated mainly between Collipuli in the Province of Malleco, and Puerto Montt in Llanquihue, along the line of the Longitudinal Railroad and on the island of Chiloe, where some railroad has also been built. Lumber and forest products rank first in volume and value of traffic on the state railroads (which do not include some of the ore and nitrate-carrying roads of the north). Most of the lumber is heavy, requiring rail transportation to get it out, and drivable streams are practically non-existent. Much of the forested country is of such rough topography that railroad construction will be exceedingly difficult; hence the timber, if it is ever logged, will be very costly. This is true in the southern provinces and also in the *Araucaria* forests farther north.

Logging is done mostly during the three or four summer months, from December to April, because of the heavy rains during the other eight months. Southward from Puerto Montt the summer also is rainy and the total precipitation in some places reaches 130 inches per annum. Roads are very poor, yet logs or lumber are hauled out by ox teams, often from places 30 miles from a railroad. Much of the lumber is produced on the large estates, in connection with clearing the land for agricultural use. Operations are numerous, numbering several thousand, but are mostly rather small, and few mills can cut more than 10,000 to 15,000 board feet a day. Many of them are portable mills, which saw from 200,000 to 600,000 board feet at one "setting," then move on to the next. Circular saws are used almost exclusively.

Lumber is generally rather poorly manufactured, and because it is cut in the summer, followed by a long rainy season, it is very difficult to dry. Except in a few sash and door factories, kiln drying is practically unknown. The high cost of exploitation and transportation,

together with the poorly manufactured product, explain why northern and central Chile import large quantities of Douglas fir and other lumber.

The wood-using industries rank in importance after flour milling and wine making. They include furniture, vehicle, sash and door, box, match, and flooring factories, manufactures of railroad and street cars, planing mills, ship and boat building, cooperage, and many others. The construction and box industries consume the largest quantities of lumber. Other large users are the furniture factories, which produce 90 per cent of all the furniture used in Chile, and the wine makers, who require large quantities of rauli staves.

In 1911 there were reported to be 675 factories making wooden products, and 189 furniture and 188 vehicle factories, with a combined capital of $15,555,000. Valdivia, with the surrounding region, is one of the most important centers of wood-using industries, and Santiago and Valparaiso also have many factories.

Forest Management.—The exploitation of Chile's forests has been characterized by an utter lack of consideration for their continued productivity, with the result that the forests of the northern provinces have been entirely destroyed except for a few small remnants, while those of the central region not only have been greatly reduced in area but the stands that are left are composed chiefly of comparatively inferior species, such as coihue, radal, and maqui, instead of the roble which once predominated. Farther south, the valuable rauli, cedro, and alerce are gradually disappearing, and their places are being taken by less valuable species.

Only within the last two decades has there been a Forest Service, whose duty it is to encourage planting by private owners and to establish plantations on the dunes of the Chanco region. During this period some areas of public forest have been reserved and put under control of the Forest Service. Although planting on the dunes began about 1900, only a few thousand acres have yet been planted out of the million acres or more that ought to be covered with forest.

Private owners have gone considerably farther than the government and planted some 150,000 acres altogether, beginning about 1895. Considerable areas of agricultural soil have been planted to fast-growing trees, such as poplar and eucalypts, which produce fuelwood, posts, and box boards on rotations of 7 to 15 years and pay even better than agricultural crops. Coal-mining companies in Concepcion and Bio-bio provinces have planted areas totaling 140,000 acres, of which one company alone has over 85,000 acres. For nearly 15 years this company has secured most of its mine props from its own plantations, which are now ready to supply saw-timber also. The principal species planted are *Pinus*

insignis, Pinus maritima, Eucalyptus globulus, Acacia melanoxylon, Cupressus macrocarpa, Cupressus torulosa, and *Robinia pseudacacia.*

Forestry Laws.—In order to check the cutting of small trees of alerce, which was fast disappearing, a decree was issued in 1859 forbidding the cutting in public forests of Chiloe and Llanquihue of alerce boards less than 7 inches wide and 7 feet long. This law was never enforced, however, and the cutting of young timber went on.

In 1872 a law was passed which provided for the regulation of cutting in public forests and prohibited cutting in certain places where landslides would result. The regulations issued during the following year also forbade clearing by fire north of the Bio-bio, but permitted it south of that river. Provision was also made for exploitation of state forests, and an Inspector General of Forests was provided. Owing to the lack of funds, however, a personnel was not provided to guard and administer the forests and to enforce the other provisions of the law; these duties were left to local administrative officers, with the result that the law remained largely a paper one.

In 1879 there was reserved a strip 10 kilometers wide along the foot of the Andes, from the Bio-bio to southern Llanquihue, and strips one kilometer wide on either side of the coast range in the same provinces. No further alienations were to be allowed within these strips. In 1908 a law declared private lands within state forests to be of "public utility," and provided for the expropriation of up to 200,000 acres of them. At about the same time the state began to set aside or acquire lands needed for protection of watersheds of the cities of the Republic, and in 1912 the Inspector General of Forests, Fish and Game was given control of all such lands already acquired or to be acquired in the future. During this same period the policy was adopted of establishing forest reserves to be managed definitely for the purpose of timber production, and up to 1914 eight such reserves, totaling about 1,600,000 acres, had been set aside.

Secondary Forest Products.—*Soap-bark.*—One of the most important forest products exported from Chile is the bark of quillai (*Quillaja saponaria*), which contains a large proportion of saponin, used in soap manufacture. The exports of this material rose from 1,470 metric tons in 1900 to 1,975 tons in 1911, being valued in that year at nearly $75,000. In 1915, 2,274 tons was exported, of which the United Kingdom took 1,726 tons, United States 293 tons, Argentina 97 tons, France 86 tons, and Spain 35 tons. While data as to domestic consumption are not available, it is certain that a considerable quantity is used. The north central provinces are the principal producers of quillai bark.

Tannin.—The barks of lingue and canelo contain from 15 to 30 per cent of tannin, and ulmo and peume are also used. Lingue bark was

formerly exported in quantity, but now is mostly used locally. In 1900, 638 tons was exported and in 1911, 759 tons. The pods of tamarugo, algarrobo, and algarrobillo also used to be an important article of export for tanning purposes, as they contain from 35 to 50 per cent of tannin and in some cases up to 65 per cent, but heavy cutting for fuelwood, together with fires and grazing, has greatly reduced the supply. In 1900, 1,311 tons of pods were exported, principally from the northern provinces, while in 1911 less than one ton was shipped. During recent years an important tanning industry has grown up in Chile itself, centering at Valdivia. The domestic consumption of tanbarks and soap bark together has been estimated at 60,000 tons yearly. Harvesting of bark is still carried on in a wasteful manner, frequently without utilizing the timber at all. In 1915 Chile imported 372 tons of quebracho extract, most of which came directly from Argentina, and the rest from France and Germany. Exports of tanbark and extract to the United States in 1920 were valued at $14,000.

Distillation Products.—The wood-distillation industry, which has barely begun to develop, is believed to have a great future. Large areas of forest in the southern part of the Republic, as well as a considerable proportion of the stands in the commercial saw-timber section, are better suited to distillation than to any other use. There is at least one plant on the island of Chiloe, operated in connection with a large sawmill, which has a considerable output of alcohol, acetone, tar, and charcoal.

Cork.—Chile imported 339 metric tons of cork and cork products in 1911 and 135 tons in 1915. In 1915 Spain furnished 69 tons, Denmark 21, Germany 17, United States 14, France 5, and the United Kingdom 3 tons. There is no native substitute for cork, but it is stated that cork oak thrives in central Chile and may eventually be grown there.

Naval Stores.—In 1911 Chile imported turpentine, rosin, and various naval stores products to the amount of 4,738 tons, valued at more than $100,000. In 1920, although the quantity was less, it was valued at more than $600,000. Practically all came from the United States. Although alerce, cipres, and araucaria are reported to be possible sources of limited amounts of resin, it is not likely that they will ever be very important sources. The plantations of maritime pine made on the sand dunes by the state and on other lands by mining companies, however, may in time be able to supply domestic requirements for naval stores. A project is already under way to work some of the older plantations for their resin.

Wood Pulp.—The paper and pulp industry is not yet very important. Chile imports four-fifths of the paper she uses, and the total consumption is only about 15,000 metric tons. Of the 10,000 tons of newsprint

imported in 1915, Sweden furnished 3,000, Norway 2,000, United States 2,400, United Kingdom 600, and other countries 2,000 tons. The three or four paper factories in Chile consumed in 1915 about 4,000 tons of pulp, imported mostly from Germany. One mill in Talca uses poplar for making pulp, and a mill established recently near Valdivia will use local raw material. It is reported that steps have recently been taken toward developing a paper industry in Cautin province, in the *Araucaria* region. Chile has large supplies of material suitable for making paper pulp, and may be expected to develop an important industry. One of the best sources of material is quila (*Chusquea quila*), the bamboo which is common in the forests of southern Chile. Coihue, lingue, olivillo, and araucaria are also suitable for pulp making.

The Probable Future.—It is not likely that Chile will ever have very much surplus wood to export. While it is perhaps true that she now has in the south a large surplus of overmature material that ought to be removed from the forests, geographic and economic conditions do not favor the rapid development and marketing of this material. Moreover, the population is growing and wood requirements may be expected to increase very greatly in a country which still has such great undeveloped resources as has Chile, so that the present forest area cannot be counted on to yield continuously a surplus over domestic needs, if indeed it can supply them.

The better species, such as alerce, cedro, and rauli, are becoming scarce in the accessible districts, and these and several of the other valuable species, including laurel, roble, and lingue, will last only a few decades at the present rate of consumption. A great deal of the best timber is on land that eventually will be cleared for farming, and meanwhile extensive areas of mountain land are being devastated by fires.

It is probable, therefore, that instead of exporting much timber Chile will have to extend greatly the productive area of her forests in order to meet her own requirements. This can be done because a very large proportion of the land surface is better adapted for timber production than for any other use.

Chilean Trees.—Among the many species native of Chile, the following are of the greatest commercial value:

TABLE 332.—PRINCIPAL TREES, CHILE

Alerce (*Fitzroya patagonica*) is a large coniferous tree, the wood of which resembles redwood (*Sequoia*) in a general way. Like redwood, it reaches a great age, in some cases reported to be as much as 4,000 years. It occurs mostly in the provinces of Valdivia, Chiloe, and Llanquihue, and is no longer abundant. The wood is red in color, soft, easy to work, and very light, weighing 32 pounds per cubic foot (dry). It shrinks and checks but little, holds its place well, is fairly strong, and is very durable. It is the most valuable native lumber and is used for planing mill prod-

TABLE 332.—PRINCIPAL TREES, CHILE—*Continued*

ucts, interior and exterior finish, shingles, ceilings, furniture, and other general purposes.

Arrayan (*Eugenia apiculata*) has very hard wood, used in carriage building.

Avellano (*Guevina avellana*) has light-colored hard wood, suitable for furniture and flooring. It checks and twists where exposed to the weather.

Canelo (*Drimys winteri* or *D. chilensis*) reaches large size and is abundant. It is never attacked by rats or other vermin, is much used in interior work, and is suitable for furniture.

Carbon (*Cordia decandra*) is comparatively small and rare. Its yellowish brown wood with black markings is used for ornamental veneer and cabinet work.

Cedro or cipres (*Libocedrus chilensis* and *L. tetragona*) are medium-sized, coniferous trees, still fairly common in the mountains, but less abundant in the more accessible regions. The wood is grayish brown, with lighter spring wood, is soft, strong, easily worked, and very durable in use, even in the soil. It is fairly light, weighing 36 pounds per cubic foot. It makes excellent posts, railroad ties, and telephone poles, and is also used for interior work, rafters, and planing mill products. It ranks next to alerce in value.

Ciruelillo (*Embothrium coccineum*) has pinkish, striped wood, lustrous when polished, which is one of the best for fine furniture and cabinet work. It is also suitable for flooring.

Coihue or coigue (*Nothofagus dombeyi*) is a large evergreen beech, one of the most abundant trees in the saw-timber forests. Its wood is hard, strong, and fairly easy to work but difficult to season. It is very heavy, weighing about 60 pounds per cubic foot. The dark red wood is durable and resembles roble (*Nothofagus obliqua*), for which it is often sold. The more common yellowish pink or whitish form is perishable when exposed to the weather, and checks badly when used inside, so is not considered valuable. It is used for low-grade construction work and for other purposes where durability is not essential. The white form, which is abundant, is a possible source of paper pulp.

Laurel, or laurela (*Laurelia aromatica*) is a large tree, very abundant in some districts. Its yellowish or olive-colored wood is hard, strong, flexible, and light, weighing only 36 pounds per cubic foot. It has a fine texture, and is easy to work, but shrinks and checks considerably in drying. It is used to a large extent by box makers, and the better grades are utilized for trunks, furniture, ceiling, flooring, and other planing mill products. Another species (*Laurelia serrata*), also called laurel or huahuan, is very abundant toward the south, where it is very largely used for interior work. It is not so good as the northern species.

Lingue (*Persea lingue*) has a wood that greatly resembles white oak, and has similar uses. It is brown or yellowish in color, with conspicuous rays, rather coarse texture, and straight grain. It is hard, strong, stiff, and moderately heavy, weighing 48 pounds per cubic foot. It works easily, and seasons and takes stains well. Lingue is the best native wood for furniture, pictures, and cabinet work, and is used also by wheelwrights and carriage makers. Its bark is much sought for tanning.

Litre (*Litraea caustica*) has very hard wood, hard to split, and is employed for wagon hubs.

Luma (*Myrtus*, or *Myrceugenia, luma*) has been called the hickory of Chile. It is a large tree, especially abundant in Chiloe and adjacent regions. Its dark red wood is very compact, hard, strong and resilient. Weighing nearly 70 pounds per cubic foot, it makes an exceptionally good fuelwood. It is highly valued for tool handles, spokes and other vehicle parts, and cooperage, and is utilized also for ties and general construction.

TABLE 332.—PRINCIPAL TREES, CHILE—*Continued*

Mañiu (*Podocarpus andina, P. nubigena,* and *P. chilina*) are conifers of rather limited distribution in the Andes and southern Chile. The wood is light yellowish or brownish, soft, straight-grained, easy to work and season, and keeps its shape well. It is fairly light, weighing 38 pounds per cubic foot, and is strong. The principal uses are planing mill products, furniture, and vehicle bodies.

Manui (*Saxegothea conspicua*), which is abundant in the Chiloe region, has soft wood of fine appearance, used for furniture and flooring. It is not durable when exposed to the weather.

Meli (*Myrtus,* or *Myrceugenia, meli*) resembles luma both in appearance and in its uses. It is fairly abundant in the same region.

Pino, pinon, pehuen, or araucaria (*Araucaria imbricata*), is a conifer belonging to the same family as the Parana pine of Brazil. It reaches large sizes and is abundant in the higher mountains of a limited section of the country, extending across into Patagonia. The wood is yellowish or brownish white, fairly soft and strong, easy to work, but hard to season and not durable. It weighs nearly 50 pounds per cubic foot, or considerably more than Douglas fir. It is not much exploited because of its location, but is used to some extent for construction and planing mill products. The wood is suitable for making paper pulp.

Radal (*Lomatia obliqua* and *L. dentata*) is employed to some extent in the manufacture of furniture, and also makes good flooring.

Rauli (*Nothofagus procera*) furnishes one of the most widely used woods in Chile and is one of the most valuable of the more common kinds. It is a large, tall tree, and has been very abundant, although the supply is being cut into at a rapid rate. Its wood, weighing only 42 pounds per cubic foot, is much lighter than roble and the other beeches, and is also much softer and easier to work. It is reddish in color, has a fine texture and satiny luster, and bears a considerable resemblance to the black cherry of North America. It seasons and holds its shape well, and takes a fine polish. It is the principal sash and door wood of Chile, and is used also for interior trim, panels, ceiling, flooring, furniture, and trunks, and is the best wood in Chile for tight cooperage.

Roble, or roble pellin (*Nothofagus obliqua*) is one of the most abundant timber trees of Chile, and its wood is used in greater volume than any other. It is reddish in color, hard, strong, and very heavy, weighing over 60 pounds per cubic foot, and though easy to work is very hard to season, because of its tendency to warp and check. It is exceedingly durable even in the soil, and is much used for railroad ties, telephone poles, piling, shipbuilding, and general construction.

Roble de Chiloe (*Nothofagus nitida*) and roble de Magallanes (*N. betuloides*) are large trees, abundant in the extreme southern part of the country, but their wood is not durable and is much inferior in quality to that of the northern roble.

Tenio or teniu (*Weinmannia trichosperma*) is a fairly common tree with durable, hard, red wood, used in foundation work, for railway ties, and in vehicle work.

Tiaca (*Weinmannia paniculata*) has flexible wood, durable in moist situations, and widely utilized in boat construction.

Ulmo or muermo (*Eucryphia cordifolia*) is most abundant on the island of Chiloe and southward. It reaches very large sizes, being used by the Indians for dugout canoes. The wood is reddish brown, hard, strong, close-grained, durable in water but not in soil, and works easily, although it is rather hard to season. It weighs about 52 pounds per cubic foot. It is used for flooring, furniture, vehicle work, interior construction, and for ties in the rainless nitrate region. The bark is rich in tannin, and is harvested on that account.

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COLOMBIA

Extent of Forests.—The productive forest area of Colombia has been estimated at about one-half of the total land area or, in round figures, 150,000,000 acres. This is approximately 27 acres per inhabitant.

Very little is known about the extent of forests before settlement by Europeans or changes since then. Considering the comparatively sparse population and low requirements for wood, and also the climatic conditions prevailing in most of the forested country, it is probable that the original area has not been greatly reduced. Some forests have been destroyed in the region of Bogota and also in the coastal regions, where bananas, sugar, and other crops are raised.

Character of Forests.—Being a country of extreme variation in topography, with altitudes extending from sea level to above 18,000 feet, Colombia has a great diversity of climate and consequently of forest growth. The forests may be classified broadly as follows:

1. Mangrove forests, which cover extensive areas along the Caribbean coast, especially between the Sinu and Magdalena rivers.

2. Open deciduous forests of the dry regions, characteristic of the Caribbean coastal region eastward from the Sinu River, and especially of the Goajira peninsula.

3. Evergreen tropical forests, occurring at the lower elevations along the Magdalena, Cauca, Sinu, Atrato, and other rivers in the region of the Pacific coast, and in the region tributary to the Amazon.

4. Forests of the higher altitudes, where a temperate climate prevails.

No data are available as to the relative proportions of the different types of forest. It is known, however, that the tropical forest occupies by far the larger part of the total area, while the areas of mangrove and of dry forest are rather limited in comparison.

The mangrove forest is the same type which is common to a large part of the northern and eastern coasts of South America as well as other parts of the Caribbean. While the principal species is *Rhizophora mangle,* other mangroves of lesser importance occur. It is valuable chiefly as a source of tanning material.

The dry belt of the northern coast of Colombia and Venezuela is characterized by open stands of rather short trees, often thorny and mostly belonging to the *Leguminosae.* Mature trees average from 1 to 2 feet in diameter and about 25 feet in height, and very few are more than 50 feet tall. This forest furnishes firewood and small timbers, and contains some products which are important articles of trade. Such are the wood of guayacan or lignum vitae (*Guaiacum* sp.), Brazil wood or fustic (*Caesalpinia tinctoria*), and the pods of divi-divi (*Caesalpinia coriaria*), used for tanning.

The tropical forests are varied in composition and in economic value. In some districts, palms of various species are important components of the stand. Along the rivers are strips of more or less swampy forest, subject to inundation during certain periods of the year. These are com-

posed of species, mostly of very rapid growth, many of which have wood fairly light both in color and in weight. The stands are irregular and under existing conditions, of rather low commercial value. They eventually may become valuable sources of wood for pulp or for certain other purposes. Characteristic species are:

Ceiba blanco—*Bombax* sp. or *Ceiba* sp.
Ceiba colorado, or tolu—*Eriodendron* sp.
Jobo—*Spondias lutea.*

On higher ground the forest is much more varied, with a large number of species, most of which have hard, heavy wood. Among the important species in the Magdalena region are:

Cedro (Spanish cedar)—*Cedrela.*
Albarco (Colombian mahogany)—*Cariniana pyriformis.*
Caracoli (espave)—*Anacardium rhinocarpus.*
Diomate, gusanero, or gateado.—*Astronium graveolens.*
Roble—*Tecoma* spp.
Balsa—*Ochroma* spp.
Olla de mono—*Lecythis* spp.
Mazabolo, abarco or guino.
Canalete—*Aspidosperma excelsa.*
Balsamo—*Myrospermum erythroxylum.*
Caoba (mahogany)—*Swietenia* sp. (not abundant).
Guayacan polvilla, araguaney, or Maracaibo lignum vitae—*Tabebuia* or *Tecoma* sp.
Copaiba—*Copaifera officinalis.*
Carreto.
Cariano.
Laurel.
Encenillo.

Important palms are tagua (*Phytelephas macrocarpa*) whose nuts yield vegetable ivory; ceroxylon (*Ceroxylon andicola* and another species), a source of vegetable wax; corozo palm and others which yield oil; and coconut palm, which occurs near the Caribbean and Pacific coasts. Several rubber-bearing trees also occur, including *Hevea* and *Castilloa* and one or more species of zapote from which chicle is obtained. East of the Andes, on the rivers tributary to the Amazon, the forests are a continuation of the Amazon forest described in the chapter on Brazil.

The stands in virgin forest seldom exceed 15,000 board feet per acre in volume, and the better stands average between 8,000 and 10,000 board feet per acre, while others are not so good. As in the other tropical forests of South America, there are several distinct stories, the upper of which, containing the greater part of the saw-timber, is composed of comparatively few species. Here trees attain heights of from 130 to

165 feet. Below are two or three lower stories, of which the two lowest are composed of rather small trees of a great variety of species.

The tropical forest is mostly below 5,000 feet in altitude. Higher up it gradually gives way to species of temperate climates. Along the upper Magdalena, as well as other rivers, a large willow (*Salix humboldtiana*) is abundant, and is of some economic importance. On the mountain slopes are such species as:

Nogal, or cedro negro—*Juglans columbiana* or *J. bogotensis.*
Roble—*Quercus granatensis,* and *Q. humboldtiana.*
Pino (Bogota white pine)—*Podocarpus taxifolia* and other species, which are the only native conifers.

Ownership.—While considerable areas of forest have been alienated and converted to agricultural use, and others have been either granted outright to private owners or leased for exploitation of the timber, rubber, or other products, by far the greater part of the forests is still owned by the government. Definite figures as to ownership are not available.

Annual Growth.—The net annual growth is probably very small, as is usually the case where most of the forests are still in a virgin condition. Some of the individual species grow extremely rapidly under favorable conditions; *Cedrela,* for instance, is reported to reach merchantable size in ten years. The average rate of growth of the species composing most of the forests, however, is rather slow or only moderately fast. It is probably safe to assume that the total net growth does not exceed the cut, which is about 110,000,000 cubic feet a year.

Annual Cut and Loss by Fire.—The annual cut of lumber is very small. Such statistics as are available indicate a consumption of about 13 million board feet in the five principal commercial towns and adjacent territory, with a population of about 300,000. On the basis of these figures, the total cut of sawed and hewed lumber and railroad ties for the entire country is probably somewhat over 120 million board feet, or 10 million cubic feet. Almost all of this is either hewed or sawed by hand. A great deal more wood is cut for fuel, charcoal, and fencing than is cut for lumber and timbers, and while no information as to the quantity cut is available, it must be at least 100,000,000 cubic feet.

As most of the forest is in regions of very heavy rainfall, the annual destruction by fire is probably very small.

Exports and Imports.—Colombia exports only small quantities of wood, principally Spanish cedar and Colombian mahogany from the Caribbean region, and largely through the port of Cartagena. Most of it goes to the United States, either directly or by way of Porto Rico. In 1916 the wood exports were:

	Metric tons
Brazilwood	142
"Quebracho" dyewood	70
Mora	112
Lignum vitae	7
"Woods" (mostly cedar and mahogany)	1,873
Total	2,204

The average annual exportation of woods from 1906 to 1918 amounted to 3,459 metric tons, or approximately 200,000 cubic feet.

Imports of lumber are also comparatively unimportant in quantity and value. The greater part of the population is in the interior of the country, where transportation costs prevent the importation of such bulky products as lumber. Moreover, there are abundant supplies of native woods, better suited to the climate and more termite-resistant than the woods from North America. It is stated that railroad ties of native hardwoods last 8 years, while creosoted imported ties last but 3 years. Practically all of the lumber that is imported is consumed in or near the coast towns, of which the most important are Barranquilla, Cartagena, and Santa Marta. More than 80 per cent of the total is southern yellow pine. In average normal years imports are about as follows (in thousands of board feet):

Kind of wood	Barranquilla	Cartagena	Santa Marta	Total
Southern yellow pine	1,000	600	60	1,660
American white pine	120	40	20	180
Other American woods	100	35	20	155
Total	1,220	675	100	1,995

This is equivalent to about 170,000 cubic feet, or a little less than the volume of exports, and practically all comes from the United States.

Domestic Consumption.—In most of Colombia, wood is used in building only for sash, doors, blinds, posts, rafters, and flooring. In some districts, on the other hand, houses are customarily built of wood. A very important building material in some parts of the country is the bamboo-like cana brava, which is used for framing and rafters. Among the larger consumers of lumber are the railroads, of which there were 740 miles in 1918, ship and boat-building establishments, and banana and coffee plantations. Lesser amounts are used by various manufacturers of

wooden products, such as furniture, boxes, matches, implements of various kinds, and vehicles.

Altogether the total annual consumption of lumber and timbers, including railroad ties, is probably about 120 million board feet, or 10 million cubic feet, of which less than 2 per cent is imported. This is a per capita consumption of 22 board feet, or a little less than 2 cubic feet of sawtimber.

Although the consumption of wood for fuel, either directly or after being converted into charcoal, is enormous, no satisfactory basis for estimating the quantity is available. Colombia has extensive coal deposits, but these are not yet developed on a large scale, so wood is very largely used for heating and cooking as well as for firing under the boilers of the river steamers and of some of the railroads. As a large part of the population, and especially of the more civilized portion, live in the cooler regions of the interior, the domestic fuel consumption is probably somewhat above the average for countries lying within the tropics, and can hardly be less than 100,000,000 cubic feet a year. This makes a total wood consumption of about 20 cubic feet per capita.

The Lumber and Wood-Using Industries.—The lumber industry of Colombia is yet in a primitive state and has not expanded to any great extent during recent years. Excepting a very few sawmills in the coastal region, there are practically none in the republic. Most of the domestic lumber is squared by hand in the woods, and cut into cants of such size that they can be packed out on burros. It is then taken to the consuming centers, where it is resawed by hand into boards.

Most of the lumber, excepting the more valuable woods for special purposes, is cut fairly close to where it is used. The forests have been cleared away from the vicinity of some of the larger towns like Bogota and Medellin, however, and in those cases transportation from considerable distances is necessary. Transportation facilities are entirely inadequate, consisting of only 740 miles of railroad, mostly narrow gauge, and a few good roads. The main arteries of communication have been the rivers, especially the Magdalena, which is navigable for some 900 miles, the Cauca, the Sinu, and the Atrato. It is impractical to ship lumber either from the interior down to the coast or from the coast up to the interior consuming districts. The great southeastern territory, tributary to the Amazon, is almost uninhabited, and is practically unexploited except by rubber gatherers.

Manufactures of wooden products are of comparatively little importance in Colombia. Most of the furniture used in the country is made there from native woods, but the total consumption is small. Practically all of the work in furniture and cabinet shops is done by hand, and the same is true of the shops making wagons and other vehicles.

The soap and candle makers and the brewers require considerable quantities of boxes, some of which are made from imported shooks and the rest from native woods. Match factories use small quantities of wood. Perhaps the largest consumers, aside from the building industry and the railroads, are the boat makers.

Forest Management.—Such cutting as has been done has had no regard for the future of the forest. Logging for cedar, mahogany, and other special kinds of wood consists merely of culling single trees scattered through the stands, and does not materially change their appearance, although it results in a gradual deterioration in the quality of the remaining timber. Cutting of wood for fuel and general rough uses, however, frequently means clean cutting and eventual disappearance of the forest.

A decree of 1907, regulating the cutting of timber from public forests, provides that for every cedar tree cut two small ones shall be planted. At least one private lumber company is planting cedar and getting the native wood-cutters to do the same, in order to supplement the waning supply tributary to its mill. It is said that cedar will yield sawtimber in 10 years after planting; the general application of this statement, however, has been questioned.

In some localities in the interior considerable cheap lumber and fuel wood is now obtained from planted trees of willow, pines, and eucalypts.

Forestry Laws.—The forestry law of May 31, 1907, provides that those lands shall be considered as national forests "which are reserved from denouncement as agricultural lands, and which contain woods valuable for construction, ivory nuts, cinchona, rubber, gutta percha, balsams, resins, and other exportable products." These are under control of the Ministry of Public Works, which may grant concessions or leases for periods not exceeding 20 years, nor more than 7,500 acres (3,000 hectares) per person. In case of associations or corporations, larger areas may be granted, but between each individual grant there must be a reserved strip of 7,500 acres. Apparently there is no administration of the national forests except where concessions are made, and there the administration consists chiefly of inspecting the work of exploitation.

The decree of August 13, 1907, specifies the conditions under which concessions may be granted, and lays down rules governing the extraction of woods, ivory nuts, rubber, barks, and other products from the national forests. Among other things, it provides that only trees that have reached complete development shall be cut; young trees or sprouts needed to restock the forest must not be cut; bark may not be removed from standing trees unless the trees are also taken; in extracting rubber, due care must be used not to destroy the trees, and the method of chipping and number and size of the cuts must follow specified instructions;

ivory nut palms must not be cut at any age; for each cedar or mahogany tree cut, two young trees of the same species must be planted.

Secondary Forest Products.—As far as articles of commerce are concerned, Colombia's forests have so far been much more important for rubber, barks, oils, gums, and nuts than for timber. The principal products are:

Vegetable Ivory.—Tagua palm (*Phytelephas macrocarpa*) is widely distributed on the lower Magdalena, the Atrato, and in the Pacific coast region. Its nuts, from which vegetable ivory is made, form one of the important articles of export from Colombia. In 1913 exports of tagua nuts amounted to 11,650 metric tons, valued at approximately $800,000. During the period 1906 to 1917 the average annual export of tagua nuts was 8,163 tons. About 85 per cent went to the United States, where they are used by button manufacturers and other industries.

Tanning materials.—Among the tanning materials found in Colombia are mangrove, divi-divi, and algarrobo. Exports of mangrove bark, practically all of which go to the United States, vary very widely from year to year, having reached 780 tons in 1916 but averaging less than half of that amount. Some attempts have been made to develop an extract industry in Colombia, and shipments of extract from Cartagena to the United States exceeded 3,000,000 pounds in 1916. This factory since then has ceased to operate. The pods of divi-divi (*Caesalpinia coriaria*) are gathered in large quantities in the dry belt of the Goajira peninsula and adjacent territory. Production averages around 6,000 tons a year, and exports average about 4,000 tons, going for the most part to the Dutch port of Curaçao, whence they are reexported. Other sources of tannin are the pods of algarrobillo, or algarrobo (*Caesalpinia brevifolia*, and those of guara (*Paullinia sorbilis*), both of which are very high in tannin content. Neither are exploited on an extensive scale.

Rubber.—Rubber is one of the more important commodities exported. Various rubber-yielding species are widely distributed over the tropical regions of the country. A few plantations have been established on the Atrato River, near Tumaco on the west coast, and in the Department of Santander. Labor is scarce and undependable, however, so these plantations find it hard to compete with the East Indies. Most of the rubber produced in Colombia is gathered from the wild forests. Considerable quantities from the southeastern territories go out by way of Iquitos in Peru and Manaos in Brazil. Export figures show a considerable variation from year to year, but in good years more than $700,000 worth of rubber is sent out from Colombia, a very large proportion of it going to the United States. In 1917 the United States took nearly 600 long tons of Colombian rubber. Balata is another important rubber gum produced

in limited quantity in Colombia; 250 tons was exported to the United States in 1917.

Chicle.—The chicle export industry is of very recent development, exports to the United States, which takes it all, having increased from 5,200 pounds, valued at $1,800, in 1916, to 1,778,000 pounds, valued at $570,000, in 1919. Several species of zapote, bearing chicle or its substitute, lirio gum, are widely distributed in the tropical parts of the country, but the industry, so far, is mainly confined to the lower Magdalena Valley and the Atrato region near the Pacific coast.

Medicinal Barks.—Fifty years ago Colombia led in the production of cinchona bark, with an export in 1875 valued at nearly $10,000,000. The bark, which came from the Amazon forests, was gathered in a very wasteful manner. The quinine plantations of the British East Indies and Java developed a bark with higher alkaloid content, and conducted the business so much more efficiently that the price of quinine sulphate dropped from $4.01 an ounce, in 1879, to $0.61 in 1885, practically putting an end to the Colombian industry. Several other medicinal barks and roots are produced in small quantities.

Medicinal Gums and Balsams.—"Balsam of copaiba" and "balsam of tolu" are exported from Barranquilla and Cartagena to the amount of about 110,000 to 120,000 pounds a year. The first named, which makes up most of the total production, is an oleo-resin from the copaiba or canimi tree (*Copaifera officinalis*) which is found throughout the tropical parts of the country.

Resins and Waxes.—Colombia is very rich in supplies of vegetable waxes and resins, but they are almost unexploited because of scarcity of labor and difficulty of transportation. One of the most important is the ceroxylon palm (*Ceroxylon andicola* and another closely related species) which produces a wax very similar to the carnauba wax of Brazil. Large quantities are used for candle making, but one is exported. Quika resin, from *Cercidium spinosum*, is another product which may become important.

Vegetable Oils.—Important sources of oils, but little developed as yet, are various palms, especially the very abundant corozo palm, the tucan palm, and the coconut palm. In 1918 about 36,000 pounds of coconut oil and 80,000 pounds of corozo oil were exported.

Dyes.—Although small quantities of brazilwood and mora, or fustic, are exported, they do not take an important place in the total export trade.

The Probable Future.—Colombia is still very sparsely populated, but has great potential resources, and also has the advantage of location close to consuming centers of the West Indies and the Gulf Coast of the United States. Lack of population, and consequently of labor, have hin-

dered development, and for the same reasons transportation facilities have not been built up on a scale adequate to promote industrial and commercial expansion. But now that modern methods of sanitation, as developed at Panama, have shown the way to overcome the obstacles of the tropical climate of the lowlands, while at the same time the Panama Canal has put Colombia more on the direct line of world trade, it may be expected that before many years her agricultural, mineral, and forest resources will be exploited on a large scale. It has been estimated that only one-third of the total area is suitable for agriculture, which leaves a very large area of land below timber-line that will be used for producing wood. Of the potential agricultural area comparatively little is yet utilized.

Colombia has extensive deposits of coal, and some oil fields have been discovered. Many minerals are found all through the mountainous parts of the country, there being about 18,000 mining operations in the five principal departments. Development of these mineral and agricultural resources, together with the railroad construction that must go with it, will require great quantities of timber. It is likely, therefore, that while the lumber industry will expand very considerably within the next few decades, domestic requirements for its products will expand just about as rapidly, so that Colombia will not become an important lumber-exporting nation. Her exports of cabinet woods and hardwoods for other special uses will probably increase to some extent to help in replacing the waning supply of such materials in the United States. Economical large-scale development of her forests can take place only when it will be possible to market all, or at least the major part, of the timber stand, instead of selecting the scattered trees of one or of a very few species as is done now. This can come about only when the local demand increases sufficiently to use the lower-grade material.

Trees of Colombia.—A few of the better known trees occurring in Colombia are listed below.

TABLE 333.—IMPORTANT TREES, COLOMBIA

Balsa (*Ochroma lagopus* or related species) is the well-known "corkwood," used for making rafts, floats, life preservers, and similar articles.

Balsamo (*Myrospermum erythroxylum*) has hard wood used for rough construction, docks, cars, and boat building.

Campano is used for dugouts and boats. It reaches very large size.

Canalete (*Aspidosperma excelsa*) is related to the perobas of Brazil. The wood is used for construction, flooring, furniture, and vehicle parts. It is hard and rather difficult to work.

Canimi (*Copaifera officinalis*) has very hard and durable wood, used for flooring, cabinet work, vehicles, and construction exposed to the weather.

Caoba, or albarco (*Cariniana pyriformis*) yields the Colombian mahogany, of which considerable quantities have been exported during the last 40 years. It is fairly

TABLE 333.—IMPORTANT TREES, COLOMBIA—*Continued*

abundant in some districts, and reaches large size, with a straight bole averaging about 3 feet in diameter and clear of branches for 50 feet. The wood, which weighs 42 pounds per cubic foot, resembles true mahogany, for which it is often sold, and is put to similar uses.

Caracoli, called espave in Panama (*Anacardium rhinocarpus*), a source of moderately soft construction lumber, is fairly common.

Carreto has strong, durable, hard wood, used for high-grade flooring, furniture, and heavy vehicles.

Cedro, or cedro real (*Cedrela odorata* or closely related species), is Spanish cedar, the wood of which is exported for cigar-box material and finish, and is very generally used in most countries of tropical America for general construction, furniture, and interior finish. The trees, which reach large size, are scattered in distribution, although the supply is abundant in the aggregate.

Cedro caoba (*Swietenia* sp.) is true mahogany, either the same species as that of the West Indies or a closely related one. It is of rather rare occurrence in Colombia.

Ceibo blanco (*Ceiba pentandra*, or *Bombax* sp.) is a large, common tree of rapid growth, with soft, porous, light-colored wood. It is not strong and is very perishable and is therefore of low value for lumber.

Ceibo colorado, or tolu, has wood which is also soft and light, but is pinkish in color, stronger and more durable than ceibo blanco, and is used to a considerable extent for cheap lumber.

Diomate, or gusanero, the gateado of Venezuela (*Astronium graveolens*) has hard, heavy wood, valued for furniture and cabinet making.

Drago, or dragon tree, is an exotic species planted to some extent around Medellin, and used for cheap lumber and boxes.

Encenillo (*Weinmannia* sp.) furnishes cheap lumber used in building and for common furniture.

Guayacan, or lignum vitae (*Guaiacum* sp.), and

Guayacan polvilla (*Tabebuia* sp. or *Tecoma* sp.), which resembles true lignum vitae, are exported in small quantities, and are used for furniture, novelties, and railroad ties. The trees are rather small, and the wood is extremely heavy, hard, and durable.

Jobo (*Spondias lutea*) is a large, fast-growing tree, with soft, light wood, which checks and warps in seasoning. It is used to some extent in making matches and for boxes, and with careful seasoning might make good cheap lumber.

Laurel furnishes common lumber for general use.

Mazabalo, or abarco, resembles Spanish cedar in color and structure, but is harder, heavier, and stronger. It is much used for rough building construction, and in general for the same purposes to which American yellow pine is adapted.

Olla de mono, or monkey-pots (*Lecythis* spp.), are abundant in the tropical forests, and furnish good lumber and crossties.

Nogal, or cedro negro (*Juglans* spp.), are species of walnut found in the temperate mountain districts. The wood resembles American black walnut, and is used for furniture, interior finish, and to some extent for general construction.

Pino (*Podocarpus taxifolia*, and possibly other species) is the only conifer native to Colombia, where it occurs in the higher mountain districts. Its wood is soft, light-colored, and fairly strong, and somewhat resembles white pine. It is used for sash, doors, blinds, ceilings, and interior finish, and is fairly common in the markets of the interior.

Roble or "oak" is of two kinds, the tropical one being a species of *Tecoma*, whose wood slightly resembles oak and is used for similar purposes. The roble of the cooler

TABLE 333.—IMPORTANT TREES, COLOMBIA—*Continued*

mountain regions is a true oak (*Quercus* sp.). It is used for construction, flooring and furniture, but is not very abundant.

Sauce (*Salix humboldtiana*) is a large willow, abundant on the bottom lands of the upper Magdalena River. Its wood furnishes cheap lumber for light construction and boxes.

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SURINAM (DUTCH GUIANA)

Extent, Character, and Distribution of Forests.—The greater part of Dutch Guiana is hilly and covered with almost impenetrable forests, which have been very little explored. There is some open savanna land in a narrow belt near the coast, and also in the mountainous districts near the Brazilian boundary. The forests cover fully 90 per cent of the total land surface, or approximately 26,500,000 acres, which is equivalent to 290 acres per inhabitant. Although some limited areas nearest the settlements along the coast have been over-cut, very little of the original forest has been destroyed. The total cultivated area is only about 65,000 acres, or three-tenths of one per cent of the land surface, and much of this was savanna land before it was cultivated.

The forests are very similar to those of British Guiana, almost all being of the mixed tropical evergreen type, and except for a narrow belt near the coast, they are in virgin condition. The better-known species include mora, greenheart, purpleheart, ironheart, cedar (*Cedrela*), snakewood, letterwood, wallaba, and balata, but there are hundreds of others which eventually will be of economic importance.

Forest Industries.—The principal product exported from Dutch Guiana is balata, of which normal exports exceed 1,000 tons a year,

worth about $1,250,000. The balata tree (*Mimusops globosa*) occurs scattered through the forests, and even those in many of the more remote districts have been tapped by the natives. Methods of exploitation are primitive and wasteful, and therefore the production of balata is declining. Small quantities of rubber are exported.

A limited amount of timber cutting is done near the coasts and larger streams, but there has been none above the first series of falls, which are about one-fourth of the distance from the coast to the heads of the rivers. Logging methods are very primitive, nearly all of the work being done by hand. Recently, one operator has commenced to use steam skidders. There are about five sawmills, one of which cuts cedar, while the others cut hardwoods.

Timber Cut, and Exports, Imports, and Consumption of Forest Products.—The total cut of timber for all purposes, including fuel, is probably about 1,500,000 cubic feet. About 3,000,000 board feet of hardwoods is exported, mostly in the log and therefore equivalent to about 500,000 cubic feet. The principal species exported are: mora, which goes to Great Britain; greenheart, to England, Netherlands, France, and Germany; purpleheart and brownheart, to Netherlands and France; snakewood and letterwood, to Europe and the United States. The greater part of the total export goes to the Netherlands, where it is used for dock construction, ties, and fine furniture. In 1919 and in 1920 an average of about 30,000 board feet, principally wood classed as "mahogany," was exported to the United States. Imports of wood are very small, although 30 years ago considerable quantities were brought in from the United States and British Guiana. In 1920 only 18,000 board feet of yellow pine was imported. Manufactures of wood, especially furniture, were imported from the United States to the value of about $3,000 in 1919 and $21,000 in 1920.

Wood consumption is small, because of the scanty population (2 per square mile) and the limited use of wood. The greatest amount probably is used for making charcoal, while some is required for building construction, wharves, small boats, barrel staves, and railroad ties. There are about 100 miles of railroad in the colony. The total consumption of wood is estimated at approximately 1,000,000 cubic feet per annum, or 11 cubic feet per capita.

The Probable Future.—Dutch Guiana has a very large supply of timber, which includes many species excellently adapted for ship and dock construction, general building construction, railroad ties, furniture and cabinet work, vehicles, handles, and many other uses. These forests have not been exploited hitherto, because of the lack of population and capital necessary to develop means of transportation. While there appears to be no reason for anticipating much change in conditions in

the near future, it can hardly be doubted that eventually much of the timber will reach the general market.

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ECUADOR

Extent of Forests.—The forest area of Ecuador is estimated at 90,000 square miles, or 57,600,000 acres, which is 76 per cent of the total area and about 29 acres per inhabitant. The forest area, as well as the total area of the country, depends upon the settlement of boundary disputes between Ecuador, Colombia, and Peru. While no figures are available regarding the original area under forest or the rate at which clearing is going on, it is known that large tracts have been cleared for raising cacao, coffee, sugar, tobacco, and other crops, and the area of such cultivation is gradually being extended.

Character and Distribution of Forests.—There are three well-defined forest regions in Ecuador. The northwest coastal region from the Gulf of Guayaquil northward, except for some semi-arid districts of limited area, is an extension of the tropical forest of the Pacific slope of Colombia. It is composed of a large number of species, mostly evergreen hardwoods, with some softer woods and many palms. Along the shores are extensive belts of mangroves. The mountain region is a very rough, broken country, with much non-timbered land, and with tropical forests in the deeper valleys, and subtropical or temperate forests on the slopes and in the higher valleys. These forests are similar in character to those of the corresponding regions in Colombia and Peru. East of the Andes is the "Montaña" or "Oriente" region, a hilly country gradually merging into the plain of the Amazon and for the most part densely forested with the very complex tropical forest characteristic of the Amazon region. The Galapagos Islands, 730 miles west of the mainland, have some tropical forests which are not of great value.

The first of these three divisions is of the greatest economic importance at the present time, because it is the most accessible. It embraces about one-ninth of the total forest area, or 6,400,000 acres.

Character of Ownership.—There are no data available as to ownership of the forest lands of Ecuador. Much of it is still owned by the state, however, although large areas in the northwestern part of the

country have been acquired by individuals and corporations. As the government does not attempt to restrict cutting of timber on its lands, there is no particular incentive for the native population to acquire ownership of lands chiefly valuable for their timber.

Annual Growth, Annual Cut, and Losses.—While potentially the annual increment is great, actually it is not, because the forests are not under management and most of them are in a virgin condition. They are not subject to fire danger, hence there is no loss from that source. The net growth is probably slightly less than the annual cut, or about 50,000,000 cubic feet a year.

While the annual lumber cut is fairly large in comparison with some of the neighboring countries, it is a very small fraction of what the forests of the country would warrant. There are only a score or so of sawmills, of which about a dozen are important. In addition to what these mills cut, a great deal of lumber is sawed by hand. The total production of lumber is probably not less than 60,000,000 board feet, or 5,000,000 cubic feet, and may be considerably more. About 100,000 cubic feet a year is cut for railroad ties, and the consumption of wood for fuel, fencing, dugout canoes, and foundations of houses is very considerable, probably at least 50,000,000 cubic feet. The total annual cut is estimated at not less than 55,100,000 cubic feet, or about one cubic foot per acre of forest land.

Exports and Imports.—Large quantities of lumber were exported from Guayaquil to other parts of the west coast of South America, but this trade has declined with the competition of softwoods from the United States. Small quantities of cabinet woods for furniture and other special uses are exported to Peru, a little to Colombia, and occasionally small shipments are sent to the United States. More or less bamboo lath is sent to Peru and Chile. The total amount of wood exported probably does not exceed 25,000 cubic feet a year.

Twenty-five or thirty years ago Ecuador imported about 10 million board feet of southern yellow pine a year from the United States. After several disastrous fires, however, an ordinance was passed forbidding the use of coniferous wood in building in Guayaquil. The result was an almost complete cessation of imports, except for small quantities used by the railroads and some of the plantations. The values in round numbers of lumber imports during the period 1912-1916 were: 1912, $92,000; 1913, $75,000; 1914, $45,000; 1915, $37,500; 1916, $33,000. The corresponding quantities of lumber, chiefly Douglas fir and yellow pine, were from about 2,100,000 board feet in 1912 to 750,000 board feet in 1916, with an average of 1,200,000 board feet or 100,000 cubic feet. A very high import duty on lumber, designed to protect the home industry, also contributes toward keeping imports at a low figure. In

1919 and 1920 imports fell to an average of about 25,000 cubic feet a year, but will probably rise again to approximately the level of a few years ago.

Domestic Consumption.—The total annual consumption of lumber, timbers, and railroad ties is probably at least 5,175,000 cubic feet a year, and of fuel, fencing, and other material at least 50,000,000 cubic feet, making a total of 55,175,000, or 27.6 cubic feet per capita.

The Lumber and Wood-Using Industries.—The lumber industry has been relatively of considerable importance in Ecuador for a great many years. The forests of the Guayaquil region and of the northern coast are accessible, and Guayaquil, having the only sheltered deep-water harbor suitable for ship-building yards on the west coast of South America, was long an important center of the ship-building industry. Both native and imported woods were used. In the early years most of the native lumber was sawed by hand, and much is still cut in this way in the interior, it being considered by many to be superior to that made in sawmills.

In 1915 there were about two dozen sawmills in the republic, of which 11 were in or near Guayaquil, 3 at Esmeraldas, and the others scattered. Some of the mills in these two districts are fairly efficient and modern, while the others are more primitive. None is equipped with dry-kilns. Both circular and gang-saws are used. The lumber cut in the interior comes mostly in short lengths, seldom more than 7 feet long, because it has to be brought out to market over mountain trails, usually packed on burros.

Practically all of the wooden commodities manufactured in Ecuador are made by hand, in small shops. This applies to sash and doors, interior finish, furniture, woodenware, and various other articles.

Forestry Management and Forestry Legislation.—Very little interest has been taken in forestry in Ecuador, either by the government or by private individuals. Some private owners in the districts where timber is not abundant, especially in the valleys of the mountain region, have planted considerable eucalyptus in forest plantations, and some of it has been a fairly important local source of lumber, posts, and fuel. It is reported that there is no control over cutting, even on public forests; an individual who wishes to cut timber from the public lands merely helps himself, asking nobody's permission.

Secondary Forest Products.—Up to the present time, Ecuador's most important forest products, as far as export trade is concerned, have been vegetable ivory (cadi, corozo, or tagua nuts) and rubber. Before the war exports of ivory nuts averaged about $900,000 in value and nearly 40 million pounds in quantity, while exports of rubber were nearly one million pounds, valued at almost $700,000. Some cinchona bark,

also called cascarilla and Peruvian bark, is exported also, and other products sometimes classed as forest products are toquilla fibre (from *Carludovica palmata*), used in making Panama hats, and cacao, which used to be gathered wild but now is largely grown in plantations. Guayaquil cane, which strictly speaking is not lumber, is used for lath, roofing, and even for framework of buildings. It sometimes reaches heights of almost 100 feet.

The Probable Future.—The opening of the Panama Canal has brought Ecuador much nearer to the wood-consuming centers of the world; moreover, she has several good natural harbors, and forests containing many valuable woods within fairly easy reach, besides others which will be tapped by lines of railroad already proposed. It seems probable, therefore, that the exportation of hardwoods may again become an important factor in her commerce. At the same time, the domestic demand will gradually increase, and it is possible that softwood construction lumber from the west coast of North America may be required in steadily increasing quantities.

Ecuadorian Woods.—Among the many species of woods native of Ecuador are the following:

TABLE 334.—PRINCIPAL WOODS, ECUADOR.

Alcamfor is used for chests and wardrobes.
Algarrobo (*Prosopis dulcis, P. horrida, P. juliflora*) is used for posts, tool-handles, charcoal, and foundations of houses.
Aliso (*Alnus*?, or *Betula acuminata*?) is used for flooring and general carpentry.
Amarillo (several kinds) is extensively used for bridges, mine timbers, and general construction.
Arrayan (*Eugenia* sp.) is used for house posts and railroad ties.
Balsa, or palo de balsa (*Ochroma piscatoria*?) is used as a cork substitute, and for lining iceboxes. Logs are cut up to 60 feet long.
Balsamo (*Myrospermum peruiferum*), also called sandalwood, has hard, durable wood, used for furniture and construction.
Bantano is used for construction.
Bella maria is used for interior woodwork, construction, and shipbuilding. Logs are cut up to 65 feet long.
Cabicu is a cabinet wood.
Cachacomo makes good lumber.
Caimito (*Chrysophyllum cainito*) is used for lumber.
Canelo (several kinds) has hard wood, widely used for construction where great strength is not required.
Cañafistula (*Cassia fistula*) makes good lumber.
Canje is also used for lumber.
Caoba (*Swietenia* sp.?) resembles mahogany and is used for similar purposes.
Capuli (*Prunus saliciifolia*) is a cherry, used for lumber.
Caracoli is a valuable cabinet wood.
Cascol claro and cascol oscuro, also called iron wood, are hard, heavy woods used for construction.
Cashaguiro is used for lumber.

TABLE 334.—PRINCIPAL WOODS, ECUADOR—*Continued*

Cedro (*Cedrela* sp.) is not especially abundant in Ecuador. Its wood is valuable for sash, doors, ceilings, panels, and interior finish. It is also used for furniture and cabinet work.

Ceibo (*Bombax* and *Eriodendron* spp.) is a large tree with soft, light, and rather perishable wood, used for boxes and temporary construction.

Chamburo (*Carica papaya*) is used for lumber.

Chicarron (*Terminalia chicharronia*) is found in some markets.

Chigmay makes fairly good lumber.

Ciruela (*Spondias purpurea* and others) furnishes rather soft lumber, useful for some purposes.

Copal (*Hymenaea* sp.) has hard, heavy wood, suitable for furniture and posts.

Coquito or coguito has strong, elastic wood, used for vehicles. It has some of the properties of hickory.

Cueharillo has hard wood, used for bridges and mine timbers.

Ebano (*Caesalpinia* sp.) has dark colored, hard, heavy, durable wood, used for cabinet work. It resembles ebony.

Fernan sanchez makes fairly good cheap lumber.

Figueroa is a large tree, whose wood is easy to work. It is used for house frames, common lumber, sash and doors, and cabinet work. Its wood is reddish brown in color, very durable, even in the soil, and strong. There are some almost pure stands of this species near Esmeraldas.

Guachapeli has strong, hard wood used for spokes and felloes and for boat-siding.

Guadaripo is used for dugout canoes.

Guanabana (*Anona muricata*) is used for lumber.

Gualtaco, guapula, and guarara are used for mine props, and the last one also for telephone poles.

Guaropa has hard, durable wood.

Guasango is abundant, and is extensively used for flooring and other purposes.

Guayabo (*Inga edulis*) is used for construction.

Guayacan (*Guaiacum officinale*? or related species) is fairly plentiful. It is used for house posts, rafters, telephone poles, and railroad ties, and also for furniture.

Guayaquil cane (*Guada angustifolia*) is similar to bamboo. It occasionally reaches 100 feet in height. It is split into slats or lath, and is used extensively in building houses.

Guayumo (*Cecropia peltata*) is a fast-growing tree with soft wood of little lumber value, but which may be valuable for pulp.

Guion furnishes construction timber.

Higueron has light, perishable wood.

Habasquiro makes good lumber.

Jigua and jujan have durable woods.

Laurel (*Nectandra laurel* and others) includes several species with valuable woods, though they are not abundant in western Ecuador. Laurel blanco is not durable, but laurel negro and laurel de puna are. They are used for construction and furniture. Laurel negro has dark brown wood somewhat resembling Circassian walnut.

Lengua de vaca or palo de vaca (*Galactodendron* sp.), sometimes called satinwood, is used for furniture.

Madera negra or palo prieto (*Erythrina glauca*) has hard, durable wood, used for about the same purposes as guayacan.

Majagua (*Anacardium rhinocarpus*) is the same wood as the espave of Panama.

TABLE 334.—PRINCIPAL WOODS, ECUADOR—*Continued*

Mamey colorado (*Achras mammosa*) and mamey mata serrano (*Mammea americana*) are both used for lumber.

Mangle colorado (*Rhizophora mangle*), the most valuable mangrove, is abundant along parts of the coast. Besides being valuable for tanning, it is extensively used for construction, ties, piling, and fuel.

Mascarey is used for dugout canoes.

Moral has very hard wood, extensively used for construction.

Niguito is used for spokes and felloes.

Nogal (*Juglans* sp.) is somewhat like black walnut, and is used for cabinet work.

Palo cacao is the wood of the cacao tree (*Theobroma cacao*). It is used to some extent for boxes and light construction.

Pechiche (*Vitex gigantea*) is an abundant tree, whose wood is extensively used for naval construction, ceiling, siding, tanks, silos, and tubs.

Quiebra-hacha or quebracho has very hard wood. It is not the same as either of the quebrachos of eastern South America.

Quitasol is used for lumber.

Roble (*Tecoma* sp. and probably others) has wood resembling a white oak. It occurs in nearly pure stands in some localities. There are several kinds, roble blanco, roble colorado, and roble prieto. The wood is extensively used for flooring, interior finish, and furniture.

Sanon is used for mine timbers.

Sandalo is used extensively for lumber.

Sapon has white, soft, light wood, easy to work.

Sauce (*Salix humboldtiana*) is a large willow of the Andes valleys, of considerable value locally for cheap lumber.

Seca, or ceca, is a common hardwood, used for construction and cabinet work.

Soto has hard, durable wood, used for bridges and mine timbers.

Suche is used for common lumber and also for cabinet work.

Sumi, tangare, tocte, matache, platuquero, pumamaqui, and tulumbaco are occasionally found on the lumber markets.

Most of these woods are found in the western and mountainous regions, although many occur east of the Andes as well. In the Oriente region there are also many other species, whose names and uses are less well known than those of the western species.

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FRENCH GUIANA (CAYENNE)

Extent and Distribution of Forests.—French Guiana has a narrow coastal belt of flat savanna land, rising to a broken or rolling country with low mountains, mostly less than 1,500 feet high, and reaching 2,600 feet in the extreme southwest. Except for a narrow belt of savanna land near the coast, where most of the population is concentrated, practically the entire colony is covered with forest. Only about 10,000 acres is cultivated, and the total area of open country is only a few hundred square miles. About 21,000,000 acres, or 98 per cent of the colony, is forested.[1] This is approximately 420 acres per inhabitant, if the aboriginal tribes of the interior are counted.

Character of Forests.—Along the coast are considerable tracts of mangrove forest, similar in composition to that of Venezuela and northern Brazil. Near the European settlements there is some second-growth forest on old cut-over areas, composed principally of fast-growing trees with soft, rather inferior wood, such as various species of *Cecropia* (bois canon). The great bulk of the forests, however, are typical virgin stands of evergreen tropical hardwoods, composed of two hundred or more economically valuable species in all sorts of combinations. The swampy or savanna lands, often subject to overflow, have fewer species and not quite as heavy stands as the upland forests, which correspond to the "terra firme" forests of the Amazon basin. The most common species of economic value are:

Manil—*Symphonia globulifera*
Parcouri—*Platonia insignis*
Wapa—*Eperua falcata*
Goupi—*Goupia glabra*
Courbaril—*Hymenaea courbaril.*

The first four are moderately light woods, weighing from 40 to 50 pounds per cubic foot, and may be used for most purposes as a substitute for oak or teak. Courbaril is somewhat heavier, and is an excellent wood for heavy construction, railroad ties, and furniture.

The upland forests are extremely dense, and the trees are tall and comparatively slender, with straight, clean boles. Average diameters are less than 24 inches, and of the trees more than 16 inches in diameter only 2 per cent, on the average, exceed 40 inches, and only 0.4 per cent

[1] Other estimates give as low as 70 per cent.

are 4 feet or more in diameter. Clear length is usually about 65 feet, and there are from 18 to 35 merchantable trees per acre, averaging about 30, with a merchantable volume of approximately 3,500 cubic feet per acre. There are several hundred species in all, and usually about 30 species on any single acre. In spite of this extreme heterogeneity, however, a few species usually dominate, and some of them frequently occur in groups, although not over areas sufficient to be classed as pure stands. The most abundant species of considerable economic value, with their numerical proportion in the whole stand, are:

	Per cent
Angelique—*Dicorynia paraensis*	9.7
Wapa—*Eperua falcata*	9.2
Goupi—*Goupia glabra*	5.6
Balata franc—*Mimusops* (or *Manilkara*) *balata*	1.9
Cedre gris—*Qualea rosea*	1.9
Simarouba—(*Bignoniaceae*)	1.8
Balata blanc—*Micropholis melinoniana*	1.7
Grignon franc—*Ocotea rubra*	1.6
Chawari—*Caryocar glabrum*	1.0
Wacapou—*Vouacapoua americana*	0.7

The first four and the last four of these weigh about the same as oak, and are well adapted for general construction purposes. Cedre gris is lighter, and can be used much like pine. Simarouba weighs only 25 pounds per cubic foot, and is suitable for boxes and light construction.

Growth, Cut, Exports and Imports, and Consumption of Timber.—The net growth is very small, because of the undeveloped condition of the forests. It probably just balances losses by decay and cutting. The potential growth is enormous, but cannot be realized until the entire forest area can be put in a productive state. The annual cut is small, being confined practically to supplying the limited local needs of a population of less than 50,000, many of whom use almost no wood except for fuel, and but little for that purpose. The total cut of wood for all purposes is probably not more than 550,000 cubic feet.

Imports are insignificant in quantity, amounting to only a few thousand cubic feet a year, principally white and yellow pine from the United States. Although small quantities of cabinet woods have been exported from time to time, the only regular trade has been in the so-called rosewood (*Licaria guianensis*) which is used in making perfumery. In 1909, 265 tons of this wood was exported to France, besides 25,500 pounds of extract (equivalent to about 1,160 tons of wood), or altogether about 45,000 cubic feet of wood.

The consumption of wood is small and is principally for domestic fuel, native boats, local construction of dwellings and docks, and a few other uses. There are no railroads, or wood-using industries, aside from

the rosewood extract factories, nor is there an agricultural industry of importance. The principal industry of the colony is the placer mining of gold, which uses very little wood. The total wood consumption for all purposes is estimated at about 525,000 cubic feet, or approximatey 10.5 cubic feet per capita.

The Lumber Industry and Other Forest Industries.—The lumber industry is small, and methods are extremely primitive. There are six small sawmills in the colony, four of which are operated by the penal administration, and two by private companies. They cannot saw large logs. Transportation facilities are lacking, and logging is done by hand, skidding by hand over pole roads running back from the rivers, which are navigable for only short distances from the coast. Labor is scarce and hard to interest in logging. The principal species cut are wacapou, wapa, grignon, cedre, and a little angelique, simarouba, and goupi. Practically none of the land is in private ownership. Concessions for the extraction of balata and rosewood are granted by the colonial administration, but the exploitation is not supervised and is so wasteful that the early depletion of these two species is looked for.

There are about half a dozen small factories which make rosewood extract for export to Grasse, the perfumery center of France. About 10,000 pounds a year of balata was shipped to the United States before 1914, and more to Europe. In 1920 nearly 70,000 pounds went to the United States.

The Probable Future.—Recent studies made for the French government indicate that the forests of French Guiana have great potential economic value, and can become a very important source of timber for European consumption, including woods suitable for general construction as well as fine cabinet woods and woods for limited special uses. The more important woods have been grouped in three classes:

Class 1 includes woods which can be used in France in any quantity that may be supplied, for many purposes. This includes 49 species, classed as 34 kinds of wood (several species being grouped together), and comprises 50 per cent of the average stand. Class 2 can be used in limited quantities, for special uses, being either too heavy or not sufficiently durable for general purposes. There are 22 kinds of wood, including 26 species, in this class, which comprises about 15 per cent of the stand. Class 3 includes "woods of color," or fine cabinet woods, many of which are already well known. They are scarce, making up less than 5 per cent of the stand, but will usually repay the costs of exploitation.

Another method of classification groups the woods according to relative density, hardness, and uses, in analogy with the woods commonly used in Europe. There are seven classes, overlapping to some extent. These are:

1. "Bois blancs"—light, soft woods, white or nearly so, suitable for light construction, boxes, veneer cores, and interior work, where great strength or durability is not essential. Includes 9 woods, of 10 or more species, comprising 5.8 per cent of the stand. Analogous to cottonwood and poplar.

2. Fairly light, strong woods, white, yellowish, or pinkish in color, suitable for general purposes, such as pines and spruces are used for: 14 woods of 25 species, comprising 15.0 per cent of the stand.

3. Woods similar to oak and teak, suitable for construction, carpentry, naval construction, railroad timbers: 25 woods of 29 species, comprising 40.4 per cent of the stand.

4. Woods that may be substituted for beech, sycamore, and hornbeam, for turnery, brushes, chairs, and shovel handles: 6 woods of 7 species, making 7.2 per cent of the stand.

5. Woods suitable for vehicle construction, in place of elm, ash, locust, or hickory: 9 woods of 11 species, comprising 14.3 per cent of the stand.

6. Cabinet and veneer woods, mostly richly colored or figured: 32 woods of 35 species, comprising 16.7 per cent of the stand.

7. Woods especially suitable for railroad ties, mine timbers, piling, rollers, naval construction, and other special uses: 17 woods of 21 species, making 30.8 per cent of the stand.

In order to exploit the timber, transportation facilities must be developed, including both railroad construction and the improvement of streams and harbors. It will also be necessary to import labor, as the population cannot be expected to grow very rapidly for many years. At the same time that the lumber industry is developed, subsidiary enterprises should also be undertaken, such as wood distillation plants to use logging waste and inferior species; tannin extract factories, to utilize the rich tannin content of the bark of such trees as cedre, maho jaune, maho noir, patogoie, and the wood of wapa; and mechanical pulp plants, using the softer white woods, and depending for power upon the numerous waterfalls.

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PARAGUAY

Extent of Forests.—The forest area of eastern Paraguay, or Paraguay proper, is 27,500,000 acres, or 66 per cent of the total land area. The Chaco region, west of the Paraguay River, is claimed by both

Paraguay and Bolivia, and the total area of Paraguay is variously given between 65,000 and 196,000 square miles. If we accept the figure of 97,722 square miles given by several authorities for the total area, the Paraguayan Chaco includes about 32,700 square miles, of which 9,500,000 acres or 45 per cent is more or less forested. The forest percentage for the whole country is 58, and there are about 46 acres per inhabitant.

Character and Distribution of Forests.—The Paraguay River divides the country into two regions widely dissimilar in both topography and vegetation.

Eastern Paraguay is mostly a rolling, hilly country, with several ranges of low mountains, seldom more than 1,500 feet in height. The proportion covered with forest increases toward the east, only about 25 per cent being forested west of the 57th meridian, 60 per cent between 56° and 57°, 95 per cent between 55° and 56°, and 99 per cent east of 55°. The forest is of the dense tropical evergreen type, similar in character to that in southern Brazil. It is composed of a great variety of species, most of which have hard, heavy wood, and many are of great economic value. Spanish cedar and some others have softer, lighter wood, and are even more valuable for general purposes. There are reported also to be many softer woods, valuable for making paper pulp. Many of the trees reach large sizes, and the average stands are rather heavy, though a single species seldom occurs in large amounts on small areas. Among the most important species are cedro, lapacho, urunday, curupay, incienso, petereby, timbo, ibirá-ro, guayavi, laurel negro, palo rosa, and tatané. Quebracho is not found in this region.

The Chaco, on the other hand, is a flat, low-lying region, very poorly drained, and subject to frequent inundation and also to drought. There are large treeless portions, and the forested area itself is for the most part covered with open park-like stands of palms or various kinds of hardwoods. The trees are shorter and more limby than those of the eastern forests, and stands are comparatively light. The species include most of those found in the Argentine Chaco, as well as several Brazilian trees. The most important is quebracho colorado, used for tanning, while other abundant species are quebracho blanco, quebracho coronillo, lapacho, algarrobo, guayacan, palo santo, and caranday palm. Quebracho grows taller here than in Argentina, straight logs of 23 to 26 feet in length being common, while in Argentina the average is from 16 to 23 feet. The trees are extremely defective, deduction for this cause often amounting to 60 per cent as compared with 10 per cent in Argentina.

Character of Ownership.—For many years Paraguay pursued a liberal policy in disposing of her public lands, granting enormous areas to single individuals or companies, until now only about 1,500 square miles remains in government ownership in eastern Paraguay, and almost

none at all in the Chaco, except in the most northern part of the disputed zone. The total area of forest still owned by the state is probably not more than 750,000 acres, or about half what it was ten years ago. There are numerous small tracts owned by villages or "colonies," but their aggregate area is insignificant. Most of the holdings are exceedingly large, and many are owned by foreign capitalists. One company in the east owns 2,000,000 acres, while the largest single holding in the Chaco covers 7,600,000 acres. Of course these tracts are not all forest land, but include great areas of open grazing land.

Annual Growth, Annual Cut, and Losses.—The annual growth of timber is probably rather small, although many of the species, especially in the eastern region, grow rapidly. The forests are nowhere managed for timber production, and most of them are yet in a virgin condition, with growth and decay probably balancing. Much of the timber in the Chaco is defective, and it is possible that losses from decay, insects, and the fires which occasionally burn during the dry seasons are somewhat greater than the total increment.

The annual cut is only a small fraction of what the forests are capable of producing. Only the edges along the railroads and navigable rivers have yet been touched. The total cut of timber for construction purposes has increased greatly since the temporary slump in shipments of lumber from the United States to Argentina, caused by the world war. Paraguay and Brazil made the best of the opportunity to put their woods on the Argentine and Uruguayan markets, with the result that their local timber industries were greatly stimulated.

The total cut of cabinet woods and of timber for construction, staves, posts, ties, and general purposes probably amounts to 4,000,000 cubic feet a year, which is almost twice as much as the annual cut previous to 1917. In addition, quebracho for tanning purposes is cut to the extent of 3,400,000 cubic feet (average for 1917 and 1918), compared with 2,500,000 cubic feet per year before 1917. Large quantities of timber are cut for fuel wood, probably not less than 10,000,000 cubic feet per annum in the aggregate. The total annual cut is at least 17,400,000 cubic feet.

Imports and Exports.—Paraguay imports almost no wood and only a few thousand dollars worth of wooden articles. Small quantities of wood for special purposes are imported, as well as some furniture and considerable willow for making wicker furniture.

Timber has been exported for many years, including quebracho for tanning and for railroad ties, lapacho and ibirá-ro for vehicles and shipbuilding, urunday, palo de rosa, and petereby for furniture and cabinet work, and cedro for cigar boxes. Rosario, Buenos Aires, Montevideo, and other markets along the Plate have taken considerable quantities of con-

struction timber, ties, and piling, and some has gone to Europe, especially Germany, Belgium, and France. The average annual exports during the periods 1914-16 and 1917-18 are shown in Table 335.

TABLE 335.—ANNUAL EXPORTS, PARAGUAY

Kind of product	1914–1916	1917–1918
Beams (metric tons)	38.7	43.4
Quebracho logs (metric tons)	3,915.3	1,083.7
Other logs (metric tons)	6,891.9	43,332.8
Sawed lumber (cubic meters)	1,406.0	3,155.0
Posts (number)	63,734.0	36,283.0
Staves (number)	578,280.0	1,130,391.0
Palm poles (number)	6,530.0	15,402.0
Approximate total (cu. ft.)	800,000.0	2,440,000.0

For the same periods, average exports of quebracho extract were 17,385 tons and 24,498 tons, representing 2,400,000 and 3,360,000 cubic feet, respectively. The total exports, therefore, amounted to the equivalent of approximately 3,200,000 cubic feet just before 1917 and 5,800,000 cubic feet since 1917.

Domestic Consumption.—Although wood is not generally used for building in the larger towns of Paraguay, except for sash, doors, ceilings, and some other comparatively minor uses, it is widely employed in many of the rural districts, especially in the colonies and camps established in the timber regions. The native houses are often built of upright wooden poles set close together, while some of the camps and colonies have frame houses. There are less than 500 miles of railways in Paraguay, including the private narrow-gauge logging roads, so consumption of ties and railway timbers is not great. Most of the quebracho cut for tanning is now made into extract before being exported. Wood-using industries are not numerous, but are sufficient to supply the local demand. The meat industry requires considerable box lumber, and local furniture shops use native woods almost exclusively. Wood is almost the sole fuel of Paraguay, being consumed for that purpose by practically all the factories and most of the railroads, as well as for domestic use. The total consumption of wood probably is at least 11,600,000 cubic feet, or about 14.5 cubic feet per capita.

The Lumber and Wood-Using Industries.—The lumber industry is of two kinds—the quebracho industry of the Chaco, and the getting out of cabinet woods and construction material in eastern Paraguay. In either case only the edges of the forests near railroads and

navigable streams have been touched. Although there are less than 500 miles of railroad in the country, about 2,000 miles of internal rivers are navigable by barges. Most of the logging operations are on a fairly large scale, especially in the quebracho region. Logs are hauled to the railroads by oxen, using high wheels. The construction timber is usually squared by hand in the woods, and the sapwood is generally removed from the quebracho before it is taken out. Logging can be carried on in the Chaco during only about 7 months in the year, because of floods or extreme drought during the other 5 months. Some of the timber in eastern Paraguay is rafted out, the heavier logs being attached to others of lighter species. There are comparatively few sawmills, although the number has increased within the last few years. A large proportion of the export timber is shipped in the rough, in the form of square-hewn logs, to the mills in Buenos Aires, Montevideo, and other centers. There are no planing mills in Paraguay.

Wood-using industries include local sash and door and furniture shops, box-making, and a few others. Although they are mostly organized on a small scale and are rather primitive, they turn out fairly good products and supply practically all the domestic demand.

Forestry and Forestry Laws.—There is no attempt at forest regulation in Paraguay. In the eastern portion the timber removed by cutting is quickly replaced by new growth and there is probably very little net reduction in the volume of standing timber. In the Chaco, however, growth is generally slow, methods of cutting are very wasteful, and fires are of frequent occurrence. The forest capital is therefore steadily being reduced. Paraguay has no forestry laws or forest administration. The public lands still remaining are open to colonization by actual settlers but are not being disposed of as recklessly as in the past. In case of concessions for cutting on government land, some regulation is exercised, consisting principally in collecting royalties for the products cut.

Secondary Forest Products.—*Quebracho.*—The most important forest product of Paraguay so far is tanning material from the Chaco. The principal species used in quebracho (*Quebrachia,* or *Loxopterigium, lorentzii*), the heartwood of which contains from 20 to 24 per cent of tannin. The sapwood contains from 3 to 4 per cent and the bark from 6 to 8 per cent, both of which compare favorably with oak and chestnut wood, while the bark is nearly as rich in tannin as oak bark. However, both bark and sapwood are usually wasted. Quebracho occurs throughout the Paraguayan Chaco, an area of nearly 9,500,000 acres, although only about 30 per cent of the total is continuous forest, there being numerous small openings. It has been estimated that the average stand of quebracho will not exceed 3,000 tons per square league, or about one-half ton per acre, and that the original supply of quebracho in Paraguay was

about 4,500,000 tons, of which 1,000,000 tons has been cut during the past 400 years. Other estimates indicate a supply about twice as great.

Quebracho for tanning was first exported to Europe in 1867, and the first extract factory in Paraguay was built in 1889. There are now five or six large plants in the country and several smaller ones, with a total monthly capacity of approximately 6,000 tons of extract, requiring the consumption of 360,000 tons of logs per annum. Actual production is only about half of this amount. About $8,500,000 capital, principally from foreign sources, is invested in the industry in Paraguay. Large quantities of quebracho logs were formerly exported, not only to Europe but also to Uruguay and Argentina. Now, however, practically all are manufactured into extract by the domestic factories. The annual exports of quebracho logs decreased from an average of 3,915 tons during 1914-16 to 1,084 tons during 1917-18, while during the same period exports of quebracho extract increased from 17,385 tons to 24,498 tons. Paraguay produces about 18 per cent of the world's supply of quebracho extract.

Other Tanning Materials.—Paraguay has a large number of trees, the wood or bark of which contains sufficient tannin to be worth while exploiting, and some are used locally. They include (percentages of tannin in bark, unless otherwise specified, are given in parentheses):

Aspidosperma polyneuron (2.6)
Aspidosperma quebracho blanco (4; wood, 3; leaves, 27)
Aspidosperma eburneum (wood 7)
Aspidosperma sessiflora (wood 4)
Schinopsis balansae (wood 15)
Tecoma sp. (Lapacho) (5)
Apuleia praecox (10.7)
Copaifera langsdorfii (16.6)
Alchornea triplinervia (11.7)
Croton sp. (Sangre de drago) (11.7)
Salbergia sp. (5.8)
Rheedia brasiliensis (21.6)
Ocotea sp. (10.8)
Cabralea sp. (young bark 5)
Cedrela spp. (12.6)
Guarea sp. (10)
Trichilia catigua (20.5)
Trichilia hieronymi (23)
Enterolobium timbouva (22.3)
Inga affinis (25.8)
Mimosa sp. (10.8)
Peltophorum dubium (31.2)
Piptadenia rigida (28.2)
Britoa sp. (9.2)
Campomanesia sp. (11.6)
Eugenia brasiliensis (43.4; wood 11.6; leaves 16.6)
Eugenia michellii (28.5)
Eugenia pungens (10.8)
Eugenia sp. (regalito) (15.8)
Eugenia sp. (28.7)
Myrtus sp. (21.8)
Cocos romanzoffiana (6.6)
Allophyllus edulis (10)
Cupania uruguensis (17.5)
Cupania vernalis (15)
Cupania sp. (cedrillo) (15.8)
Bumelia obtusifolia (8.4)

Paraguay Tea.—One of the most important products of eastern Paraguay is yerba maté, or Paraguay tea, the dried leaves of *Ilex paraguayensis*, a small tree common in the forests east of longitude 57° 30′. This is the most widely used beverage in Argentina, Paraguay, and Uruguay.

The production increased from 7,035 metric tons in 1915 to 11,933 tons in 1918. Formerly it was gathered entirely from wild forest trees, but recently plantations have been established and the cultivated maté may eventually form the bulk of the production. In 1915 less than 500 tons came from plantations, while in 1918 they produced 3,345 tons. About 3,500 tons a year is exported to Argentina, the rest being used at home.

Palm Oil and Nuts.—While small quantities of coconuts have been exported, recently the tendency has been toward manufacture of palm oil in Paraguay and export in this form. The total amounts produced are not large.

The Probable Future.—Paraguay is still very thinly inhabited, but has enormous areas of fertile soil capable of supporting a comparatively dense population. She also has large water-power resources in the east, capable of furnishing power for extensive manufacturing plants. The greatest immediate need is for the development of an adequate transportation system, including both highways and railroads. When these are built the forest resources will be opened up so that production can be greatly increased, and development will also take place along other lines, requiring a considerable part of the increased production of timber. Nevertheless, it is likely that Paraguay will for many years continue to export wood to the important consuming centers of Uruguay and northern Argentina, in steadily increasing quantities.

The Chaco region may increase its production of hardwoods, but the quebracho industry cannot expand beyond its present size. It is reported that one extract plant already has to get its raw material from Argentina.

Paraguayan Trees.—Some of the trees of economic importance found in Paraguay are given in Table 336.

TABLE 336.—IMPORTANT TREES, PARAGUAY

Aguay-guazu (*Pouteria salicifolia*), also called mata ojo or matta olho, is a large tree, used for construction.

Algarrobo (*Prosopis* sp.) is a comparatively small tree of the Chaco. It contains dye and tanning substances.

Ambay, or ambaiba (*Cecropia adenopus*) has light wood, used for rafts.

Aratikú guazu (*Rollinia* sp.) is a common tree, whose bark contains tannin.

Campará (*Vochysia* sp.) is a large tree with light wood, used for boxes and canoes.

Cancharana or cangerana (*Cabralea* sp.) is a common tree of large size, used for lumber. Its bark contains tannin.

Canelon pyta, or canelon colorado (*Rapanea* sp.), is used for construction.

Caranday or palma negra (*Copernicia cerifera*) is used for building and for telegraph poles. It is abundant in the Chaco.

Catigua or kaatigua (*Trichilia catigua* and *T. hieronymi*) are comparatively small trees, used for buildings. Their bark is rich in tannin and is used to some extent. It also contains dye.

Cedro (*Cedrela* spp.) includes three similar species of Spanish cedar, common in eastern

TABLE 336.—IMPORTANT TREES, PARAGUAY—*Continued*

Paraguay but not found in the Chaco. The trees are fairly large and are widely used for construction, boats, interior finish, and cabinet work. Considerable quantities are exported. The bark contains considerable tannin.

Cedrillo (*Cupania* sp.) is a small tree whose bark is of value for tanning.

Ceibo or corticeira (*Erythrina cristagalli*) has very light wood, weighing 14 pounds per cubic foot, which is used for floats and rafts.

Cumaru or cumbaru (*Dipteryx* sp.) is a fairly large tree, used for building.

Cunátuná or curátuná (*Fagara hiemalis*) is used for posts and cabinet work.

Cupay, kupaih, or copahyba (*Copaifera langsdorfii*) is a fairly large tree, used for building, and is also the source of copaiba balsam. The bark contains tannin.

Curupay or kurupaih (*Piptadenia rigida* and another species of *Piptadenia*) are rather large trees with hard, red wood, used for building, cabinet work, and railroad ties. Being especially durable in damp places, the wood is in demand for ties, piling, and bridge timbers. The bark is used for tanning. These trees are abundant.

Espina de corona (*Gleditschia amorphoides*) is used for cabinet work.

Gonçalo alves (*Astronium graveolens*) is a large tree whose wood is especially fine for cabinet work.

Guarabú, nazaré, or coraçao de negro (*Peltogyne* sp.) is a large tree, used for cabinet work and spokes.

Guaré (*Guarea* sp.) is a common tree whose bark contains tannin.

Guatambu (*Schoepfia* sp.) is a large tree, common in the north, whose wood is good for building and largely employed for rafters and boards.

Guayacan (*Caesalpinia melanocarpa*) is a rather small tree of the Chaco, with very hard, heavy, strong wood, used for turnery, axe handles, and other purposes.

Guayavi, guayaybi, or guayahi (*Terminalia paraguayensis*) has hard, strong, tough wood, weighing nearly 70 pounds per cubic foot. It is an excellent substitute for hickory for axles, spokes, and turned ware. Another species, guayavi moroti (*Patagonula americana*), is somewhat similar and is used for the same purposes.

Guaviyu, ibá vyju, yhvà-viyu, or arrayan (*Eugenia pungens*), is employed for posts and construction, and its bark for tanning.

Higuera brava, figueira brava, ibá pohy, or guapou (*Urostigma* sp.), is a large tree, used for posts.

Ibirá-pytá, ybirá pytá, virapita, or cañafistula (*Peltophorum vogelianum*), is a common large tree, excellent for building. The wood is hard, strong, and rather heavy. Another species (*Peltophorum dubium*) is similar in character. Its bark is rich in tannin and contains dye.

Ibirá-ro, iviraro, or viraro (*Ruprechtia excelsa*) has moderately heavy, hard, and very flexible wood, excellent for spokes, hubs, furniture, and boats. Another species, called palo amargo (*Pterogyne nitens*), is similar and used for similar purposes.

Ibirá-peré (*Apuleia praecox*) furnishes lumber and tanbark.

Ibirá-pepe (*Holocalyx balansae*) is a large tree, used for turnery and charcoal.

Ibirá-piú-guazú (*Diatenopterix sorbifolia*) and ibirá-obi-guazu (*Esenbeckia febrifuga*) are large trees used for building.

Ibiraré-mi is a large tree whose wood is excellent for turnery, tool handles, and wheelwright work.

Incienso blanco or cabriuva (*Myrocarpus frondosus*) is a large tree, excellent for building, shingles, and furniture.

Incienso colorado, balsamo, oleo pardo, or kaburé-ybá (*Myrocarpus fastigiatus*), has very strong, elastic, reddish brown wood used in construction and for furniture.

Inga pytá or inga guazú (*Inga affinis*) is a common tree whose wood is sawed into lumber. Its bark is rich in tannin.

TABLE 336.—IMPORTANT TREES, PARAGUAY—*Continued*

Jacarandá preto, cabiuna, palisandre, or rosewood (*Dalbergia nigra*), occurs in northeastern Paraguay. It is one of the best cabinet woods.

Jacarandá roxo (*Machaerium* sp.) is also a valuable cabinet wood.

Kambuatâ (*Cupania uruguensis*) is a fairly common tree, the bark of which is valuable for tanning.

Kôkû (*Allophyllus edulis*) is a common, small tree; the bark contains tannin.

Lapacho amarillo, tayi-sayú, piuva, pão d'arco, or ipé tabaco (*Tecoma ipé*, or *Tabebuia flavescens*), is a common, large tree, much in demand for lumber and for wagon making. It has a moderately heavy, hard, elastic, greenish-yellow wood. Much is exported to Argentina, where it is utilized for building and naval construction.

Lapacho colorado or lapacho pytá (*Tecoma lapacho*) is similar, except that the wood is dark brown.

Laurel amarillo, laurel blanco, and laurel negro include several species of *Nectandra* and *Ocotea*. All are large trees, valuable for building. White laurel has soft light wood, less valuable than the others. Black laurel is used also for furniture, posts, and ties.

Mama de porca, or mamica de cadela (*Fagara riedeliana*) has soft wood, suitable for benches and wooden ware.

Morosimó or vinhatico do campo (*Plathymenia foliolosa*) is used for posts and cabinet work.

Nandubay (*Prosopis algarrobilla*) is a comparatively small tree of the Chaco, with very hard, heavy, strong, durable wood.

Nandipa or jenipapo (*Genipa americana*) is a large tree with light wood of good quality. It is a source of dye.

Nanga-pirih-guazú, nangapyri, or ibirá yebiró (*Eugenia michellii*), is an abundant tree whose bark is of value for tanning and whose wood is used for posts and for building.

Pakuri (*Rheedia brasiliensis*) is a rather small tree whose bark is of value for tanning.

Palo blanco (*Calycophyllum multiflorum*) has fairly heavy wood of light color, employed in making furniture and interior finish.

Palo de lanza is a large tree, used for building.

Palo de rosa, or palo rosa (*Aspidosperma polyneuron*) has fairly light wood of pinkish color, excellent for furniture and construction. A similar wood, palo rosa or peroba (*Aspidosperma peroba*), is also reported to occur in Paraguay.

Palo santo, or lignum vitae (*Guaiacum* sp.), occurs sparingly in the Chaco. It has very strong, hard, heavy, durable, dark greenish wood, resembling the lignum vitae of the Caribbean region, and is used for similar purposes.

Pao santo do campo (*Kielmeyera coriacea*) makes good axe handles.

Pao carvão, or carvão vermelho (*Diptychandra epunctata*), is used for posts and construction.

Petereby, peterevi, or louro (*Cordia* spp.), are large trees with fairly light wood, which resembles black walnut and is utilized in considerable quantities for fine furniture and interior finish. Some is exported.

Pindo (*Cocos romanzoffiana*) is a palm, the bark of which is used for tanning.

Pihkásurembiú (*Bumelia obtusifolia*) is an abundant, fair-sized tree yielding tanbark.

Quebracho colorado (*Quebrachia lorentzii*) occasionally reaches 3 to 4 feet in diameter and 75 feet in height, but commonly is smaller. It is seldom straight. The wood is yellowish to dark red, weighing about 80 pounds per cubic foot, and is extremely hard, tough, and durable. It is scattered through the Chaco region in mixture with other species. The wood is fine grained and polishes well, and is used for

TABLE 336.—IMPORTANT TREES, PARAGUAY—*Continued*

cabinet work. It makes exceptionally good railroad ties, being almost indestructible, and is replacing the steel ties formerly used on the railways of the region.

Quebracho blanco (*Aspidosperma quebracho blanco*) is abundant in the Chaco region, where it reaches sizes somewhat larger than true quebracho. It has a hard, strong, close-grained, whitish or pinkish wood, weighing from 55 to 69 pounds per cubic foot, and apt to warp and twist in seasoning. It is employed in construction, turnery, and various other purposes. The bark and wood contain some tannin, while the leaves are especially rich in it.

Quebracho macho (*Schinopsis marginata*) and Quebracho coronillo (*Schinopsis balansae*) occur in the Chaco, and are of considerable value for posts and ties. They also contain tannin, but are not much exploited for it.

Quino (*Pentapanax angelicifolius*) is a large tree, with soft wood which makes good boards.

Regalito (*Eugenia* sp.) is a small tree, the bark of which contains tannin.

Samuhú, or paineira (*Ceiba* spp.) are large trees with very soft, light wood, used for cheap lumber.

Sangre de drago (*Croton* sp.) is a small tree, occurring along rivers. The bark is valuable for tanning. Another tree of the same name, which has been identified as *Heliocarpus americanus*, has soft wood.

Sapiy guazu and sapiy moroti (*Machaerium stipitatum* and *M. braziliensis*) are used for construction.

Seringueira or arvore de borracha (*Hevea* sp.) is the rubber tree, found in northeastern Paraguay.

Taperibá guazu (*Ferreirea* sp.) is a large tree whose wood is used as a lapacho substitute in wagon making and building.

Tapia-guazú-ih (*Alchornea triplinervia*) is a common, large tree. Its bark contains considerable tannin.

Tatané-sayu (*Pithecolobium scalare*) is employed in construction and cabinet work.

Tataré has golden-yellow wood, somewhat resembling satinwood. It is moderately heavy, hard, takes a fine polish, and is used for chests, and also in ship-building.

Tatayba or morera (*Maclura* sp.) occurs in northern Paraguay, and has hard, heavy, strong, yellowish wood. Tayuba is a similar and closely related species.

Tayi pirirú (*Tecoma ochracea*) is a large tree used for construction, and also contains a dye.

Tembetary-hu, or maminha de porca (*Fagara aromatica*) is a good substitute for lapacho (heartwood).

Timbo, pakora, timbauva, or oreja de negro (*Enterolobium timbouva*) is a common, large tree with strong and elastic but very light wood, weighing from 20 to 28 pounds per cubic foot. It is used for shingles, boxes, and cheap lumber. The bark is utilized by tanners.

Trebol, angelim, or imburana (*Torresea cearensis*) is a fairly large tree with wood resembling Circassian walnut, and suitable for fine furniture.

Urundey (*Astronium juglandifolium*, *A. urundeuva*, and *A. gracile*) have very hard, heavy, strong wood, used for posts and construction, and very durable, even in damp situations.

Yaguarataih (*Cupania vernalis*) is a common, small tree with bark rich in tannin.

Yata-ybá, or jatobá (*Hymenaea stigonocarpa*) is a large tree used for building.

Yhsapih-ih (*Salbergia* sp.) is a fairly common tree, yielding tanbark.

Yhvá-ika (*Ocotea* sp.) furnishes lumber and tanbark.

Yhvájhay-puihta-guazú (*Eugenia* sp.) is a fairly large but not abundant tree, with bark rich in tannin.

TABLE 336.—IMPORTANT TREES, PARAGUAY—*Continued*

Yhvá-poroitih (*Eugenia brasiliensis*) contains tannin in wood, leaves and bark. It is an abundant fruit tree of rather small size.

Yhvá-mbopi (*Myrtus* sp.), yhvá-virá (*Campomanesia* sp.), and yhvá-viró (*Britoa* sp.), are fruit trees with bark containing tannin.

Yukeri guazú (*Mimosa* sp.) is of value for tanning.

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PERU

Extent of Forests.—The total area of Peru is variously given, ranging from 460,000 to 722,461 square miles, according to which boundaries are taken. If we use the figure 683,000 square miles for the total area, the forest area is roughly estimated at a little more than half, or in round numbers 350,000 square miles (224,000,000 acres.) The population is almost as uncertain as the area, but assuming a total of 5,800,000 inhabitants, there are about 39 acres of forest per capita. Some forest has been destroyed by overcutting, and some has been cleared for agricultural use. On the whole, however, there has been very little change for centuries.

Character and Distribution of Forests.—Western Peru is practically treeless, except for scattered trees of algarrobo (mesquite) and other leguminous species, together with willows, choloco (*Sapindus saponaria*), and molle (*Schinus molle*), which occur along the streams, mostly at elevations above 6,000 feet in the south and 3,000 feet in the north. North of 8° south latitude there is some scattered scrubby tree-growth almost down to sea-level, and in the same region there is a belt of ever-

green forest, composed of more or less stunted trees, above 8,000 feet elevation.

The mountain valleys of the Andes are almost barren in the south, but toward the north they gradually merge into the "Ceja" region of the higher eastern slopes of the Cordillera, which is covered with evergreen chaparral and patches of forest. This region has vegetation of the temperate zone, including sauce (*Salix*), aliso (*Alnus*), nogal (*Juglans*), sausecillo and uncumanu (*Podocarpus*), and figueroa (*Ficus*). In the extreme northern part of the country some of the species common on the east side extend across to the west of the mountains.

The vegetation of the eastern slopes ranges from one characteristic of the temperate zone, at the higher altitudes, to a subtropical vegetation on the lower slopes, and then merges into the tropical forest of the Amazon basin. The upper slopes have an evergreen cover of chaparral and small timber, with occasional patches of larger trees. A little lower there are a great many palms of various species and a dense jungle growth, containing many trees of commercial value. Among them are cedro (*Cedrela* sp.) and other representatives of the *Meliaceae,* roble (*Ocotea* sp.) and other species of the *Lauraceae* (including *Nectandra, Ocotea,* and *Persea*), ceiba and balso (*Ceiba* sp. and *Ochroma* sp.), and many others.

Eastward from the foothills of the mountains is an almost unbroken tropical forest, part of the "terra firme" forest of the Amazon basin, and substantially the same in appearance and composition as that described in the section on Brazil. Along some of the main rivers are belts of forest subject to inundation, similar to those farther down the Amazon. While this eastern region is almost untouched, except for the extraction of rubber and cinchona bark, it contains a great wealth of timber that may eventually become one of Peru's most valuable natural resources.

Ownership.—No data are available regarding the ownership of the forest lands in Peru. Most of the forest, however, is east of the mountains, where population is very sparse, and the bulk of the land is owned by the state.

Annual Growth, Annual Cut, and Losses.—There are no data regarding these points. The net annual growth must be very small, because the forest is nearly all in a virgin condition. Many of the species composing it grow rapidly, and therefore the potential total growth is large. The annual cut also is extremely small, considering the extent of the forests. Several mills in the neighborhood of Iquitos on the Amazon cut lumber for local use, and small quantities are cut by hand on the eastern slopes and carried up the mountains to the towns in the Andean valleys. Altogether not more than 300,000 board feet, or 25,000 cubic feet, of lumber is produced in Peru. Ties used by the nearly 2,000 miles

of railway are practically all imported, as is most of the box-shook material. Considerable firewood and fencing material is produced locally, especially in the mountain valleys, and the eastern and central regions in particular consume more or less timber for house framing. The total annual cut of wood of all sorts probably does not exceed 50,000,000 cubic feet, which is less than ¼ cubic foot per acre of forest land.

Exports and Imports.—Peru exports practically no wood. Very small quantities of Spanish cedar and dyewoods are exported from the Amazon region, but the total is not more than 10,000 to 15,000 cubic feet. In 1919 the amount was approximately 12,000 cubic feet, worth $75,000.

On the other hand, almost all the lumber, ties, and box shooks used in the country are imported. For the period 1912-14 the average annual import of these products was 54,500,000 board feet, or 4,540,000 cubic feet, about 80 per cent of which was lumber and most of the rest ties. The countries supplying this material are given in Table 337.

TABLE 337.—IMPORTS OF WOOD, PERU

Country of origin	Bd. ft.	Per cent
United States	52,250,000	95.9
Chile	840,000	1.5
Europe (Scandinavia)	620,000	1.1
Central America (chiefly Costa Rica)	540,000	1.0
Ecuador	200,000	0.4
Australia	40,000	0.08
Japan	10,000	0.02

The species imported are shown in Table 338.

TABLE 338.—IMPORTS OF WOOD, BY SPECIES.

Species	Bd. ft.	Species	Bd. ft.
Douglas fir	38,000,000	Spanish cedar	540,000
Redwood	9,900,000	Southern yellow pine	400,000
North American hardwoods	1,920,000	Chilean rauli	270,000
Sugar and white pines	1,200,000	Ecuadorean roble	200,000
Sitka spruce	830,000	Australian jarrah	40,000
Baltic pine	620,000	Japanese oak	10,000
Chilean roble	570,000		

The opening of the Panama Canal made it possible for southern

yellow pine to compete with Douglas fir and redwood, with the result that of 51,000,000 board feet imported from the United States in 1918, almost 24 million feet came from the eastern United States. In 1919 and 1920, however, Douglas fir again comprised from 80 to 85 per cent of the lumber imported from the United States. Since 1917 total wood imports have averaged about 5,000,000 cubic feet a year.

The port of Callao receives nearly two-thirds of all the lumber imported, while Mollendo, Salaverry, Paita, Eten, Pacasmayo, and a few minor ports receive smaller quantities. Even Iquitos, 2,300 miles from the mouth of the Amazon in the heart of the forest region, has imported small quantities of lumber from the United States and from Europe.

Domestic Consumption.—Wood is not extensively used in building in Peru, except for ceilings, flooring, and sash and doors. Some of the railroads and mining companies, as well as some of the sugar and other plantations, use considerable quantities for construction, and some of the small communities in the eastern part of the country also have wooden buildings. The total consumption of lumber, railroad ties, and box shooks is probably about 5,000,000 cubic feet. This does not include the rough timbers used for house frames in the Amazon region, which, however, amount to little in the aggregate. Consumption of posts, fuelwood, and wood in other forms may amount to 50,000,000 cubic feet, making the total 55,000,000 cubic feet, or 9.5 cubic feet per capita.

The Lumber and Wood-Using Industries.—Except for a few small sawmills in the Iquitos region on the Amazon and a few small local operations cutting lumber by hand, the sawmill industry of Peru consists of mills in the larger towns which resaw and finish imported lumber. The reason the national lumber industry has not developed more is the lack of means of transportation between the forests and the consuming regions. Several lines of railroad have been planned to connect the western part of the country with the Amazon, and it is possible that the construction of these lines will stimulate exploitation of the forests.

Wood-using industries also are of little importance. The principal one is the planing-mill industry, which uses imported lumber. There are also several car-building and repair shops, boat-building establishments, furniture factories, box factories, and a match factory. Although a few are well-equipped, fairly large establishments, most of them are small.

Forestry and Forestry Legislation.—The forests of Peru are for the most part in a wild state. The limited patches of forest accessible to centers of consumption have been seriously over-cut to the extent that firewood is becoming hard to obtain in many places. Peru has no

forest service or other organization to control the exploitation of her forests. An executive decree of 1908 prohibits the cutting of trees in public places, except by permission of the local officials or the Department of Fomento, and requires that two trees shall be planted for each one removed. Provision also is made for establishing nurseries to supply free planting stock.

In 1919 another decree forbade cutting of timber in the region of the coast and within 12 kilometers (7 miles) of railroads, except by permission of the public authorities. Whenever a person desires to initiate or to continue a wood or timber-cutting or charcoal-making operation, he must prove his right to the tract proposed to be exploited and must get a permit from the proper official. Municipalities are to be responsible for the establishment and care of trees within a radius of 3 kilometers (2 miles), and, in cooperation with the schools, are to arrange for the celebration of arbor days. The government is to offer prizes for cultivation of trees, and the Bureau of Agriculture and Live Stock is charged with the duty of giving technical instruction in caring for trees and allotting seeds and nursery stock. All fines collected for violation of the cutting regulations are to be used for extending the woodlands of the municipalities concerned.

Secondary Forest Products.—Up to the present time the most important product of the Peruvian forests has been rubber, which occurs through most of the Amazon region. During the period 1908–12 from 4,500,000 to 5,500,000 pounds a year was exported, practically all from Iquitos. After 1914 exports fell off somewhat, but in 1919 and 1920 they were again at the old figures.

Other products are cinchona bark, not now very important in quantity or value, and vegetable ivory, or tagua nuts. Although the tagua palm is abundant in certain parts of Peru, only small quantities of the nuts are exported, about 300,000 pounds a year going to the United States in 1919–20. About 120,000 pounds a year of cinchona bark is exported to the United States, but most of the world's supply is now produced on plantations in the Dutch East Indies.

The Probable Future.—For many years, at least, Peru will not become an important exporter of timber. She has in her eastern forests very large resources, much of which would be in demand on the world markets, but Brazil and other countries have so much greater supplies, closer to the markets, that the Peruvian forests are likely to remain as a reserve for many years to come, except for high-grade cabinet woods and other special products. When the proposed railroad construction is completed it will open up the eastern region to settlement and development and will greatly expand the domestic requirement for timber. Much of this demand will be met by the local forests, although western Peru will

doubtless continue to import fir and redwood from North America as long as it can be obtained at reasonable prices, because of the heavy costs of hauling timber across the Andes.

Trees of Peru.—A few of the kinds of timber native to Peru are listed below. In the Amazon region are hundreds of other species, many of which have been discussed in the section on Brazil.

TABLE 339.—IMPORTANT TREES, PERU

Acapu, or blackheart (*Andira* sp.) is a tree of the eastern region, the wood of which is utilized for ship timbers, and is said to resist the teredo.

Aguano, which is somewhat like mahogany, occurs in eastern Peru.

Algarrobo (*Prosopis juliflora*) is the same as the mesquite of North America. It is a rather short tree or shrub, with hard wood suitable for fuel and to some extent for construction and vehicles. It occurs scatteringly near streams in western Peru.

Aliso (*Alnus jorullensis*) is a medium-sized tree of the mountain valleys.

Balsa (*Ochroma* sp.) occurs in the Amazon region.

Cedro (*Cedrela* sp.) is a fairly common tree of eastern Peru, and is cut more generally than any other species, being well adapted to a wide range of uses.

Ceibo (*Ceiba* sp. or related species) is a large tree with light, soft wood of comparatively little value, native of the Amazon region. A similar tree (*Bombax* sp.) occurs in northwestern Peru. Both yield a cotton fibre (kapok).

Chavinto is a tree of eastern Peru with tough wood.

Choloco (*Sapindus saponaria*) occurs along streams in the western and mountain regions, and is of some importance for local use.

Cocobolo is a large tree with very hard wood, native of eastern Peru.

Espintana is occasionally found in the markets.

Figueroa (*Ficus* sp.) occurs along streams in the west.

Icauba, or stonewood, has very durable wood, said to be as good as teak for construction and shipbuilding. It grows in the east.

Jacaranda, or rosewood, is cut to some extent in the Amazon region.

Jutahy, or copal wood, has very hard, durable wood, used for rollers, cogs, treenails, and heavy construction. It grows in eastern Peru.

Labauna is used for building in the east.

Massaranduba is a large tree, fairly common on the Amazon, employed for furniture, construction, and shipbuilding.

Molle (*Schinus molle*) occurs along streams in the western and mountain regions, and also in the east.

Nogal (*Juglans neotropica*) is a large tree of the mountain region, with wood resembling the butternut of North America.

Pacay (*Inga feuillei*) is a leguminous tree of western Peru, usually rather short and crooked but of value because of the scarcity of timber in that region.

Palms of many kinds occur in eastern Peru and also in the northwest. Some, such as *Bactris* sp. and *Euterpe* sp., are valuable for their wood, others, such as tagua (*Phytelephas macrocarpa*), for their nuts.

Palo mulatto, or capirona, is an Amazon species, used for beams and for fuel.

Palo rosa, similar to the peroba of Brazil, is employed for construction and other purposes in eastern Peru.

Roble blanco (*Ocotea architectorum*) is a good-sized timber tree of the western slope in northern Peru. Numerous other species of *Ocotea*, *Nectandra*, and *Persea* (all belonging to the laurel family) occur in eastern Peru, and some are found on the west side north of 9° south latitude.

TABLE 339.—IMPORTANT TREES, PERU—*Continued*

Sangre de drago is a tree of the Amazon region, with tough, hard wood.

Sauce or willow (*Salix humboldtiana*) is a tree of medium size found along streams in western Peru and in the Andean valleys. It is used for lumber, fuel, and other purposes.

Sausecillo (*Podocarpus oleifolius*) and uncumanu (*Podocarpus utilior*) are the only conifers native of Peru. The first named reaches 3 feet in diameter and 65 feet in height, and the other is larger. Their wood is light-colored, soft, and easy to work, but the supply is small. They occur in the mountain region, especially on the higher eastern slopes and on some of the western slopes in northern Peru.

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URUGUAY

Extent of Forests.—Uruguay is essentially a country of open, rolling plains, with a very limited forest area, confined largely to strips along the streams and broader patches in the more hilly country of the north. The total was reported in 1908 to be 1,071,624 acres, which is 2.3 per cent of the land area and about 0.7 acre per inhabitant. As to how this compares with the original forest area, nothing is known, although it is probably somewhat smaller. During recent years efforts have been made to increase the area by planting.

Character and Distribution of Forests.—Except for narrow belts along the streams and small areas of plantation, there are no forests in the south and central parts of the country. Toward the Brazilian frontier, however, and on parts of the basin of the Cebollati River and other tributaries of Lake Mirim on the northeast, are more extensive timber bodies.

The river bank forests are usually rather simple in composition, containing such species as willows, hackberries (*Celtis tala* and *C. sellowiana*), *Schinus dependens*, and *Ocotea*. They vary in width from a few hundred yards up to two or three miles, and in the Lake Mirim region are sometimes 6 miles wide and 70 miles long.

The northern forests are more like those of southern Brazil and north-

eastern Argentina. Palms of various kinds are abundant, and there are besides some 20 species of good hardwoods, including:

algarroba	molle
arazá	ñandubay
canelón	pitanga
coronilla	quebracho
curapé	sarendi
espinello	sombra de toro
guayabo	tala
lapacho	timbú
laurel	urunday
mata-ojo	viraro

Softer woods are sauce (willow), amarillo, and ceibo.

Besides the native woods, considerable areas have been planted to exotic species, especially poplars, eucalypts, pines, cypress, and acacias, and some of these plantations are producing sawtimber.

Ownership of Forests.—Practically the whole area of Uruguay is in private ownership. The census of 1908 showed that 42,300,000 acres, or 94 per cent of the total, was in 43,000 farms and ranches, and much of the rest must be included in urban areas. All but 0.5 per cent of the forest area was on these ranches.

Annual Growth, Annual Cut, and Losses.—No data on these points are available. It has been reported, however, that the forests of the northern part of the country are being over-cut and gradually reduced in area. Judging from what is known regarding the timber consumption of nearby parts of Argentina and Brazil and Uruguay's imports, at least 22,000,000 cubic feet of wood must be cut within the country, which is equivalent to 20.5 cubic feet per acre of forest. The annual growth may be a little less than the cut, or about 20 cubic feet per acre.

Exports and Imports.—Exports of wood, as might be expected, are very small. Thirty years ago more was exported than now, the quantities in 1894 and 1895 being approximately 80,000 and 105,000 cubic feet, respectively. Only recently the government has authorized the exportation of firewood and timber from the mountains of the Cebollati region, because the neighboring Brazilian population is entirely dependent on that section for their wood.

On the other hand, imports of lumber are large, and until the last few years consisted principally of yellow pine from the United States. More recently Parana pine from southern Brazil has become an important competitor of yellow pine. Argentina and Paraguay supply large quantities of timber, principally railroad ties, fuelwood, and fence posts, and Chile occasionally furnishes similar material. Brazil and Paraguay both send more or less cedar and other hardwoods to Uruguay. Small amounts of such cabinet woods as walnut come from Europe, and rail-

road ties have been brought from Australia. Imports of lumber in 1912 and 1913 are shown in Table 340.

TABLE 340—IMPORTS OF LUMBER, URUGUAY

Kind of wood	1912	1913
	1,000 bd. ft.	*1,000 bd. ft.*
Southern yellow pine	39,058	31,350
Spruce	9,400	6,100
Northern white pine	6,600	3,778
Austrian pine	2,600	.....
Sugar pine and western white pine	.....	1,500
Parana pine	1,200	3,000
Spanish cedar	4,420	4,300
American oak	758	.....
South American hardwoods	6,415	6,452
Others	.....	764
Total	70,451	57,244

In 1919 and 1920 imports from the United States were only 19,000,000 and 22,670,000 board feet, respectively, while the imports of Parana pine from Brazil more than made up for the decrease. These figures do not include imports of railroad ties, telephone and telegraph poles, staves, fencing, and fuelwood, which amount to a great deal in the aggregate—probably 1,500,000 cubic feet a year. Altogether about 7,000,000 cubic feet of wood is imported annually. About 80 per cent of the imported lumber goes to Montevideo and the surrounding country, and most of the rest enters at the ports of Paysandu and Salto.

Domestic Consumption.—Uruguay uses more lumber per capita than any other South American country, with the exception of Chile. Its population is almost entirely of European descent, and more than half of the total lives in cities, although the principal industry is the raising of live stock. As many of the larger ranches are being broken up and fenced, the requirements for fencing material are large. They are met chiefly by material from the Chaco region of Paraguay and Argentina, which also supplies the ties, principally quebracho, used by Uruguay's 1,650 miles of railroad. For telegraph and telephone poles, which are generally of wood, yellow pine and the South American woods furnish the shorter material, and eucalypts from Australia the tall poles used in cities. The box industry uses large quantities of wood for making shipping cases for meat products, and also for soap, candles, bottled beer, and other products. While some material is imported from the United States for this purpose, the bulk is either Parana pine from Brazil or native

planted willow and poplar. A great deal of wood is used for fuel, much of which is quebracho from the Chaco. Before the war Uruguay imported an average of about 3,100 tons of wood pulp from Sweden, Germany, and Denmark.

In all, the annual consumption for lumber, ties, pulpwood, poles, boxboards, and other large material must be in the neighborhood of 9,000,000 cubic feet, or 6.3 cubic feet per capita. The consumption of posts and fuelwood is probably about 20,000,000 cubic feet, making the total 29,000,000 cubic feet, or 20.3 cubic feet per capita.

The Lumber and Wood-Using Industries.—The lumber industry is of very little importance in Uruguay, and consists principally of resawing and planing mills in the importing centers. Some lumber is produced in the Departments of Rio Negro and Tacuarembo, and probably also in Cerro Largo, Treinta y Tres, and Rocha, in the Mirim-Cebollati region near the Brazilian frontier.

The principal wood-using industry is the manufacture of boxes and crates, which consumes large quantities of home-grown alamo and sauce (poplar and willow), Brazilian "pine," and some material imported from North America. Some furniture is made locally, using a little native and more imported wood. There is one paper mill in Uruguay, which uses imported pulp. Sash, doors, and blinds are made in small shops, chiefly from imported lumber.

Forestry and Forestry Laws.—A law passed in 1877 offered medals and cash premiums for planting forest trees, and subsequent enactments have endeavored further to encourage such planting. The law specifies the kind of trees to be planted, emphasizing particularly pines (*Pinus maritima, P. insignis, P. canariensis,* and *P. halepensis*), but allowing also various hardwoods, such as eucalypts, acacias, black locust, oaks, ñandubay, and others. Plantations under these laws have been considerable, but are not especially important from the forestry standpoint. Of greater importance are the plantations of poplar and willow along some of the streams, which are grown on short rotations and furnish considerable quantities of cheap material. About ten years ago there were reported to be over 17,000,000 trees in forest plantations, and the number is being added to constantly. The government now provides a certain amount of planting stock free of cost to land owners.

The Probable Future.—Uruguay can and, no doubt, will support a population much greater than she now has, and as the country develops, requirements for lumber and other wood will greatly increase. Having little forest land, the domestic timber production will probably never be a more important factor than it is now. Therefore Uruguay may be expected always to be an important user of imported woods. Because of the close proximity of the Parana pine forests of Brazil and the exten-

sive hardwood forests of northern Argentina, southern Brazil, and Paraguay, it is probable that they will furnish a steadily increasing share, while imports from North America will steadily decline.

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VENEZUELA

Extent of Forests.—Estimates of the forest area of Venezuela have varied as widely as have the estimates of the total area of the country. The most recent figures put the total area of productive forest at 162,250 square miles, or 103,840,000 acres, which is 41 per cent of the land area. This is 36.5 acres per capita of the total population. While the forests close to the coast and along the navigable streams have been cut and very largely destroyed, they represented a comparatively small portion of the timber area of the country, and it is not likely that the original forests were more than a few million acres greater in extent than the present ones. Clearing is not proceeding at a rapid rate now, and the forest area is therefore practically stationary. It has been reported that 98 per cent of the forest is still unexploited, except for rubber.

Distribution and Composition of Forests.—The forests of Venezuela are very unevenly distributed. The largest area is south and east of the Orinoco, extending to Brazil and Guiana, and the region in the northwest around Lake Maracaibo is also well timbered. Along the coast from Colombia to the Orinoco delta are strips of forest, rather narrow in most places, and the western Cordillera also has some timber. The great Orinoco plain, comprising a third of the area of the country, is without forest, except for two or three rather small bodies and strips of "gallery" forest along the streams.

There are several distinct types, including: (1) mangrove forest; (2) deciduous forest of the semi-arid region; (3) evergreen tropical forest; (4) subtropical and temperate forest of the higher mountains.

Mangrove forest predominates in the Orinoco delta region, and occurs along much of the rest of the coast, especially in the region of Puerto Cabello. This is similar in composition to the mangrove forests of the other South American countries, and is of much economic importance as a source of tanning material. It also contains more or less timber suitable for construction, crossties, fuel and charcoal, and for other purposes.

The mountain region along the coast has a dry climate, and is covered in some places with a scrubby growth of bushes, cacti, and stunted thorn trees. On the better sites within this region the trees are taller, the species more varied, and the vegetation is more truly a forest—rather open, and composed of short and often crooked trees, but of great economic value. This type is the source of such materials as divi-divi, algarrobilla, lignum vitae, and brazilwood.

The tropical forest varies greatly in composition, with many subtypes, ranging from the pure stands of palms ("morichales,"—*Mauritia flexuosa*) common along streams and around water sources, to the dense, mixed, several-storied stands of the Orinoco basin and the Maracaibo region. This type occurs also in sheltered spots on north slopes of the Cordillera and coast ranges, where moisture conditions are favorable. Along the streams in the great central plains region are narrow belts of gallery forest, composed, in the main, of the same species as those of the more extensive mixed tropical forest.

Among the more important timber species in the tropical evergreen type are the following:

Cedro or cedro amargo—*Cedrela odorata* or related species.
Vera—*Guaiacum arboreum*
Apamate—*Tabebuia* sp.
Canalete—*Aspidosperma excelsa*
Angelino—*Homalium racemosum*
Araguaney—*Tecoma spectabilis*
Poui or puy—*Tecoma serratifolia*
Pardillo—*Cordia gerascanthus*
Zapatero—*Peltogyne floribunda*
Javillo or juvillo—*Hura crepitans*
Mijao or mija—*Anacardium rhinocarpus*
Gateado or diomate—*Astronium graveolens*
Amarillo—*Aspidosperma vargasii*
Ceibo blanco—*Bombax ceiba* or *Ceiba pentandra*
Ceibo colorado or saque-saque—*Eriodendron anfractuosum*
Jobo or jabo—*Spondias lutea*
Balsa—*Ochroma* sp.
Guayacan—*Guaiacum officinale*
Curarire
Ebano—*Caesalpinia* spp.
Caoba—*Swietenia mahagoni* or closely related species.
Roble blanco and roble colorado—*Tecoma pentaphylla* and other species.
Balustre—*Centrolobium robustum*
Carreto
Algarrobo—*Hymenaea courbaril*
Mora—*Dimorphandra excelsa*
Laurel—*Nectandra* spp., *Oreodaphne* sp., *Aydendron* sp.
Cedro dulce—*Bursera altissima.*

The forests at the higher altitudes are similar in composition to the mountain forests of Colombia and Peru.

In general appearance, size of trees, and stands of timber, the forests of Venezuela resemble those of the corresponding types in northern Brazil and in Colombia. No data as to relative amounts of the different kinds of timber are available.

Ownership.—The greater part of the forest area still belongs to the state, which owns 72,965,000 acres, or 70 per cent, while 30,875,000 acres is in private ownership.

Annual Growth.—No data are available on which to base an estimate of the annual growth of timber in Venezuela. Considering that most of the forests are still in a virgin condition, however, it is probable that the net annual growth is very small. On the other hand, when forests shall be exploited under conservative management the potential growth will be very great because many of the species composing the stands are of rapid growth. At present, net growth and cut are probably about equal.

Annual Cut and Losses.—The annual cut of timber can only be guessed at. The annual consumption of lumber in the three towns of Caracas, Puerto Cabello, and Maracaibo, with a total population of approximately 180,000, is 7,800,000 board feet, or 44 board feet (3.7 cubic feet) per capita. Of this amount 3,200,000 board feet is imported—about all the imported lumber used in Venezuela. If we allow a somewhat smaller per capita consumption for the other cities of the republic, and a merely nominal figure for the more scattered population, the total consumption of lumber (including hewed material) must be at least 60 million board feet, or 5,000,000 cubic feet. Allowing for exports and imports, approximately 4,900,000 cubic feet is cut in Venezuela. This figure represents the volume of the finished product; there is no basis for estimating how many cubic feet of standing timber is cut to produce it.

Large quantities of wood are used for charcoal and directly for fuel, both for domestic purposes and for the river, coastwise, and lake steamers, which are the principal means of transportation, and for the railroads, of which there are only 535 miles. A very conservative estimate of the cut of this material would be 35,000,000 cubic feet, which makes the total cut 39,900,000 cubic feet. There are no data regarding losses by fire, which are probably small, or from wasteful cutting, which may be considerable.

Exports and Imports.—But little wood is exported from Venezuela. For many years dyewoods (fustic and mora) have been exported in limited quantities, together with small amounts of cedar, lignum vitae, boxwood, and other special-purpose woods. These woods have gone to

Curaçao, Europe, and the United States. In 1875, 6,600 tons of dyewoods, worth $120,000 was exported. In 1889 the quantity had increased to 10,000 tons while the value declined to $85,000. In 1888 and 1889, exports of other woods amounted to 4,000 and 2,200 tons, respectively. The total volume of wood, including dyewoods, exported in each of the years 1888 and 1889 was probably approximately 400,000 cubic feet. In 1915 and 1916 the following woods were shipped to the United States from the Maracaibo district, where most of the wood exports originate:

Species	1915	1916
	lbs.	*lbs.*
Boxwood	1,502,565	214,598
Fustic	304,000	.....
Gateado	318,000	69,000
Mora	66,580	20,000
Zapatero	1,333,797	261,610
Others	7,005	1,200,352
Total	3,531,947	1,765,560

These quantities probably represent about 60,000 and 30,000 cubic feet, respectively.

In the fiscal year 1917–1918 total exports of woods from the republic amounted to 3,312 metric tons (or about 120,000 cubic feet), worth $45,000. Exports to the United States have been increasing, and the total exports now probably amount to 200,000 cubic feet a year.

Imports of wood are small in the aggregate, although a large proportion of the lumber consumed in the more important coast towns is imported material. Just before the outbreak of the war, Caracas and Puerto Cabello and surrounding districts consumed annually between 3,000,000 and 3,500,000 board feet (250,000 to 300,000 cubic feet) of imported lumber. Of this, from 80 to 90 per cent was southern yellow pine, 6 to 15 per cent white pine, chiefly from Canada, and the rest miscellaneous species, mostly hardwoods from the United States. A large part of the pine is imported in the form of 12 by 12 inch timbers, and resawed into boards in Venezuela. The reason for this is the fact that pine timbers more than 25 centimeters (10 inches) in width and thickness are admitted free while smaller sizes are subject to a very heavy duty, in order to protect the local sawing and planing-mill industries.

Imports have not shown a tendency to increase, being about the same as 30 years ago. They may increase somewhat with the development of the oil and other industries, such as railroads. The foreign-controlled oil companies, which use yellow pine for derricks, are the only consumers of imported pine in the Maracaibo region.

Domestic Consumption.—Wood occupies a relatively minor place as a building material in Venezuela. It is used for sash, doors, blinds, rafters, and to some extent for flooring, ceilings, and interior finish, but buildings are constructed principally of other materials. Industries making wooden products are of little importance. Most of the furniture used in Venezuela is made locally, but the total consumption is not large. Boxes for soap, candles, bottled beer, rubber, and other products use considerable wood. The railroads are only about 500 miles in length and therefore consume but little wood either for construction or for crossties. The boat building and repair works are probably among the largest consumers.

Altogether, the total consumption of lumber and timber of sawtimber size must be at least 5,000,000 cubic feet. This is only 1.8 cubic feet per inhabitant. Consumption of wood for charcoal and fuel is fairly large, and some is used for fencing and other miscellaneous uses. The total consumption for all purposes amounts to at least 40,000,000 cubic feet, or 14 cubic feet per capita, and is probably more than that.

Lumber and Other Wood-using Industries.—The lumber industry is best developed in the Maracaibo region, where there are several fairly good sawmills, some of them equipped with planing mills and having furniture factories in connection. Practically all of the lumber used in the district is produced there, and small quantities are exported to Curaçao and the United States. Other important lumber-producing centers are Puerto Cabello and Valencia and surrounding districts. Caracas also has sawmills, which are engaged partly in resawing imported pine lumber and partly in sawing domestic woods. Carupano, in the northeast, and Ciudad Bolivar, on the Orinoco, are centers of timber trade for their respective regions.

The wood-using industries are small, but adequate for supplying most of the requirements of the local population. They include ship and boat building, box manufacture, vehicle construction, furniture manufacture, and the production of matches. There are several paper factories, which supply most of the domestic demand for paper. Most of the sash, doors, window frames, trim, and millwork is made by hand, from native woods.

Forestry and Forestry Laws.—Most of the cutting done so far has consisted of culling out the merchantable trees of the more valuable species. In the drier regions cutting practically clean for firewood has

resulted in the destruction of the forest cover over considerable areas. Exploitation as carried on is very wasteful, but it affects only a small portion of the total forest. The Law of Forests and Waters, in effect since 1915, provides for a Forest Service, to guard, develop, and utilize the vegetable wealth in the public forests, and also provides for a central commission or advisory board. Use of material from public forests is granted free of cost for local domestic consumption, while on areas leased for commercial exploitation fees are fixed according to the value of the product to be exploited. Concessions, or leases, run for one year, and are renewable. Only the particular species or products specified in the lease may be taken out, but another party may be granted a lease of the same area for extracting a different product. No one individual may hold more than 3,100 acres (1,250 hectares) at one time, nor may more than 5 such concessions in a continuous body be granted to an association of individuals. The federal executive may grant special concessions up to 25,000 acres for woods or 125,000 acres for other products, such as rubber.

On privately owned lands and those owned by communities, the owners and the lessees may arrange the terms of contract between themselves, but it is required that three trees be planted for each one that is cut. Cutting on watersheds affecting towns, camps, or sanitaria, is prohibited, and narrow strips of timber must be left along streams, or around springs in the grazing districts. Brushland on ridges and similar places where it is needed for watershed protection, even on private lands, must be protected. Burning of cut-over areas is forbidden, except that where the forest is to be replaced by higher culture one burning to clear up the ground is permitted. The government is authorized to furnish forest tree seeds and planting stock.

A decree of March 12, 1917, provides for the establishment of agricultural and forest experiment stations in different parts of the country. One has already been established near Caracas.

An executive decree of February 8, 1922, provides regulations governing the exploitation of forest products in accordance with the Law of Forests and Waters. Such products, including wood, bark, fruit, nuts, oils, gums, resins, and fibres, may be exploited only with permission of the Minister of Fomento, granted after application in prescribed form. The principal purpose in requiring these permits appears to be to facilitate the collection of taxes on the products, but there are certain restrictions on exploitation which, if enforced, will tend to conserve the resources. For instance, the exploitation of either public or privately owned forest must be carried on without destroying the trees, except where the wood itself is exploited, and cutting of trees yielding rubber, resins, oils, or other substances of known industrial use is absolutely

prohibited. Cutting of firewood or making of charcoal, even in connection with timber operations, requires a permit, and may utilize only dead trees or the tops, limbs, and waste of trees cut for timber. In cutting of mangrove, quinine, and other barks, young trees must be spared, and no trees less than 80 centimeters in circumference (10 inches diameter) may be bled for rubber, balata, or similar products. The method of making incisions and their extent are also prescribed, with a view to preventing the death of the bled trees.

Secondary Forest Products.—In Venezuela's foreign trade other forest products are of much greater importance than wood. Among them are rubber, balata, and tanning materials. Chicle has been exported in considerable quantity recently, and tonka beans, copaiba balsam, Brazil nuts, and dyewoods are also exported.

Rubber and Balata.—Rubber and balata gum come chiefly from the Orinoco region, whence they are exported through the port of Ciudad Bolivar. Some is taken over into Brazil, being exported from Manaos or Para. In 1888 Venezuela exported 147,000 pounds of rubber; in the fiscal year 1909-10 the exportation amounted to 716,000 pounds, and in 1917-18 to 238,000 pounds. In 1919 and 1920 exports of rubber to the United States were 522,000 and 374,000 pounds, respectively. Balata was exported to the amount of 4,399,000 pounds in 1909-10, and 2,466,000 pounds in 1917-18. The total values for both products were $2,375,000 in 1909-10, and $1,435,000 in 1917-18.

Tanning Materials.—Venezuela has extensive forests of mangrove, especially in the Orinoco delta region, as well as along most parts of the north coast. The exploitation of this resource has not yet gone very far, but some bark has been exported to the United States and Europe. In the fiscal year 1909–10, 1,069 metric tons was exported, 80 per cent to the United States. Other tanbarks used to some extent in Venezuela, which has a considerable tanning industry of its own, are: Roble (*Tecoma pentaphylla and T. leucoxylon*), curtidor (*Weinmannia glabra*), cuji (*Acacia macracantha*), aguacate, botoncillo, coco palm, gateado (*Astronium graveolens*), simaruba, tamarind, yagrumo, and urape.

The most important Venezuelan source of tannin, however, is divi-divi (*Caesalpinia coriaria*), the pods of which contain from 40 to 45 per cent of a tannin very similar to that in valonia. It is abundant in the dry forest region of the northern coast, whence it was first exported in 1769. In 1888, 3,070 metric tons of the pods was exported, worth $66,000; in the fiscal year 1909-10 the exportation amounted to 6,500 tons, worth $107,000; and in the fiscal year 1917-18, 7,557 tons, worth $150,000, was exported. Before 1914 Germany was the largest consumer of divi-divi. France, England, and the United States are the

principal other countries which use it. Venezuela furnishes about three-fourths of the world's supply of this product.

Chicle.—The gathering of chicle is a recent development in Venezuela. In 1910 only 578 pounds was exported, while five years later the exportation reached 952,000 pounds. Most of it comes from the Orinoco region, and is shipped to chewing gum manufacturers in New York.

Tonka Beans.—Sarrapia, or tonka bean, the fruit of *Dipterix odorata*, is exported from Ciudad Bolivar, on the Orinoco, to New York and Hamburg. About 200,000 pounds a year is the normal exportation. This product is used in making perfumery.

Dyewoods.—Fustic (*Chlorophora tinctoria*) has been exported from Venezuela for many years. In 1875, 6,605 metric tons of dyewood was exported; in 1889 approximately 10,000 metric tons. Brazilwood (*Haematoxylon brasiletto*) has been exported, and logwood (*Haematoxylon campechianum*) is also reported to occur in Venezuela. Some mora is also exported.

The Probable Future.—Venezuela, like Colombia, has a great surplus of timber resources beyond her present needs. Much of the forest, however, is at present rather inaccessible, and markets do not exist for all of the many species which make up the stands, hence exploitation under present economic conditions is hardly practicable. With the development of the country which is bound to take place sooner or later, however, and with the growing scarcity of hardwood timber in the United States and other countries, it is likely that great expansion of the forest industry will take place. Venezuela has great undeveloped mineral resources and vast areas of grazing and agricultural land which can support a population many times as great as the present one. Moreover, industrial development, together with reduction in the cost of lumber, when transportation facilities are improved, will in all probability result in a greatly increased per capita consumption of wood. The republic is especially well located for supplying both the United States and Europe with hardwoods, being thousands of miles closer to either than are the tropical forests of the East Indies.

Important Species.—The following are some of the species which have been listed as of considerable economic importance, among the more than 600 reported as native of Venezuela:

TABLE 341.—IMPORTANT TREES, VENEZUELA

Acapro (*Tecoma* sp.) has wood which is very heavy (75 pounds per cubic foot), hard and durable, and used for construction. Other species of *Tecoma* include araguaney (*T. spectabilis*) which has olive-colored wood of about the same weight, used for fine furniture; flor amarilla (*T. chrysantha*), similar to araguaney; palo de arco, with strong, elastic, dark red wood, weighing 60 pounds per cubic foot; poui or puy

TABLE 341.—IMPORTANT TREES, VENEZUELA—*Continued*

(*T. serratifolia*), with very strong, durable wood much used for wheels, turnery, cabinet work, and building; roble (*T. pentaphylla* and others), which resembles oak and has similar uses.

Aco (*Lonchocarpus punctatus*) has strong, tough, dark-colored wood, which lasts well under water and is used for construction. Another species of the same genus, mahoma, is widely used for making wheels.

Alcornoque (*Bowdichia virgilioides*) is a rather small tree with strong, durable, hard wood used for vehicle construction and especially good for railroad ties.

Algarrobo (*Hymenaea courbaril*) is a fairly large tree, with hard, yellowish wood, used for construction.

Amarilla, or Maracaibo boxwood (*Aspidosperma vargasii*), is a source of both dye and tannin, besides furnishing an excellent cabinet wood.

Angelino (*Homalium racemosum*) is one of the best cabinet wood species of Venezuela. The heartwood is dark olive color, with fine, even grain, weighs 53 pounds per cubic foot, and is moderately soft.

Apamate (*Tabebuia* sp.) is generally used for rough construction, flooring, sash, doors, and interior finish. It is not durable in the open.

Aspai (*Myrodia turbinata*) has fine-grained, light-colored wood, used for construction and cabinet work.

Balaustre, or cartan (*Centrolobium robustum*), is a large tree, with reddish, fairly soft wood, weighing about 45 pounds per cubic foot, and much used for cabinet work, construction, and shipbuilding.

Balsa (*Ochroma* sp.) is closely related to the balsa of Central America. Its wood is much lighter than cork.

Balsamo (*Elaphsium jacquinianum*) has soft wood, which is used for general construction.

Birote has hard, durable wood, much used for underground work.

Borracho or barbasco (*Piscidia erythrina*) has light wood, resistant to insects, and used in cabinet work.

Brazilwood or brasiletto (*Haematoxylon brasiletto*) yields a red dye.

Cabimbo (*Protium insigne*) is a very large tree with soft, light wood, used for construction where not exposed to the weather.

Caimito (*Chrysophyllum cainito*) has hard, dark brown wood, used for construction and cabinet work.

Cambima, cabima, aceite, or copaiba (*Copaifera officinalis*) has yellowish-red wood, weighing about 45 pounds per cubic foot. It yields copaiba balsam.

Canada is a large tree, with strong, dense wood, yellowish with dark veins, and used in shipbuilding and cabinet work.

Canalete (*Aspidosperma excelsa*) is a common tree, with mottled brownish or yellowish straight-grained wood, easy to work when freshly cut but very hard when seasoned. It is extensively used to make oars and paddles, and for furniture, fixtures and construction.

Caobano (*Brunella camocladifolia*), which resembles an inferior grade of mahogany, is used for boards and sheathing. Caobano blanco (*Guarea ruagea*) has soft, light, yellowish white wood, used for boxes.

Caracoli or mijao (*Anacardium rhinocarpus*) is a common tree furnishing soft, light construction wood. It checks in seasoning, and is used for boxes, cheap construction, and canoes.

Carreto is a large tree, averaging 2 feet in diameter and 90 feet in height. Its wood is strong, hard, and durable, and much used for fine flooring and vehicles, as well as for general construction.

TABLE 341.—IMPORTANT TREES, VENEZUELA—*Continued*

Cedro amargo (*Cedrela odorata* or a closely related species) is the Spanish or "cigar-box" cedar, more generally used for interior finish, sash, and doors than any other native wood.

Cedro dulce (*Bursera altissima*) is a large tree with light wood, used for boards, sheathing, and boats.

Ceiba or ceibo (several species of *Bombax* and *Eriodendron*) are large, fast-growing trees with soft, light wood. They are used for making dugout canoes, as well as for low-grade lumber and interior finish.

Cenicero (*Pera tomentosa*) has hard, fine-grained, grayish-red wood, weighing about 50 pounds per cubic foot, and used for cabinet work.

Coco de mono (*Lecythis* spp.) are common large trees, whose hard wood is used for construction and cabinet work.

Curarire is a common tree of medium size, whose hard, durable wood is used for construction.

Daguaro (*Caesalpinia* sp.) has reddish hard wood, used for building and cabinet work.

Ebano (*C. ebano* and *C. punctata*) has black wood, weighing 70 pounds per cubic foot, and used for the same purposes.

Divi-divi (*Caesalpinia coriaria*), besides being the source of pods used for tanning, has hard, close-grained wood used by wheelwrights and for turning. It weighs 80 pounds per cubic foot.

Durote (*Bocoa provacensis*) furnishes one of the best woods for furniture and cabinet work. It is hard, close-grained, reddish in color, and takes a fine polish.

Estoraque (*Myrospermum* sp.) has very elastic wood, used for barrel staves.

Fustic, or mora (*Chlorophora tinctoria*) is an important source of yellow dye.

Gateado, diomate, or tibigaro (*Astronium graveolens*) is one of the best cabinet wood species of Venezuela. Its dark-colored wood is very hard, strong, and heavy, and its bark is used for tanning.

Granadillo (*Brya ebenus*) has yellow sapwood and brown heart, is very strong, durable, and elastic, and weighs over 80 pounds per cubic foot. It is a valuable cabinet wood. *Bucida capitata*, which is similar but not as heavy, is also called granadillo.

Guacimo (*Guazuma ulmifolia*) has light, coarse-grained, grayish wood, weighing only about 35 pounds per cubic foot.

Guaimaro or charo is a common large tree with yellow sapwood and red heart, excellent for cabinet work.

Guayacan (*Guaiacum officinale*) is lignum vitae, used for turnery, axles, cogs, and other purposes where a very hard, strong, durable wood is required. Another species, palo santo (*G. sanctum*), is similar.

Javillo, jobillo, or juvillo (*Hura crepitans*) is a very abundant, large, fast-growing tree, with soft, pinkish, perishable wood, used for boxes, crates, temporary construction, and boats.

Jobo (*Spondias lutea*) is a large tree with soft, light wood.

Laurel blanco (*Oreodaphne leucoxylon*), laurel capuchino (*Aydedron* sp.) and laurel negro (*Nectandra turbacensis*) are much used for cabinet work and boat building. Their wood is easy to work, and fairly light (40 to 45 pounds per cubic foot).

Mangle colorado (*Rhizophora mangle*) is best known as a source of tanbark, but is also extensively used for rafters, posts, and fuel. The other mangroves are of less importance, but are valuable for posts and fuel.

Maria (*Calophyllum calaba*) has close-grained, yellowish wood, which takes a fine polish and is used for furniture and cabinet work.

TABLE 341.—IMPORTANT TREES, VENEZUELA—*Continued*

Mora (*Dimorphandra excelsa*) is a large, tall tree with heavy, hard, close-grained red wood, excellent for heavy construction and shipbuilding.

Nispero (*Achras sapota*) has excellent wood for barrel-staves and cabinet work, but is not cut much because its fruit and gum are more valuable.

Palo de rosa or pega-pega (*Physocalymma florida*) is a large tree whose rose-colored wood is excellent for furniture and cabinet work.

Pardillo, pardillo bobo, pardillo blanco, and pardillo de monte (*Cordia gerascanthus* and others) are extensively used for cabinet work. They work fairly well and take a fine polish.

Vera or Maracaibo lignum vitae (*Guaiacum arboreum*) is much larger than the true lignum vitae, which it resembles to some extent, and is much easier to work. It is used for furniture, flooring, and caskets, and is one of the most highly prized woods on the Venezuelan markets.

Zapatero (*Peltogyne floribunda*) is sold in the United States as West Indian boxwood. It is a rather small tree, with yellowish heartwood which is adapted to the same uses as European boxwood. It is also used for furniture and rafters.

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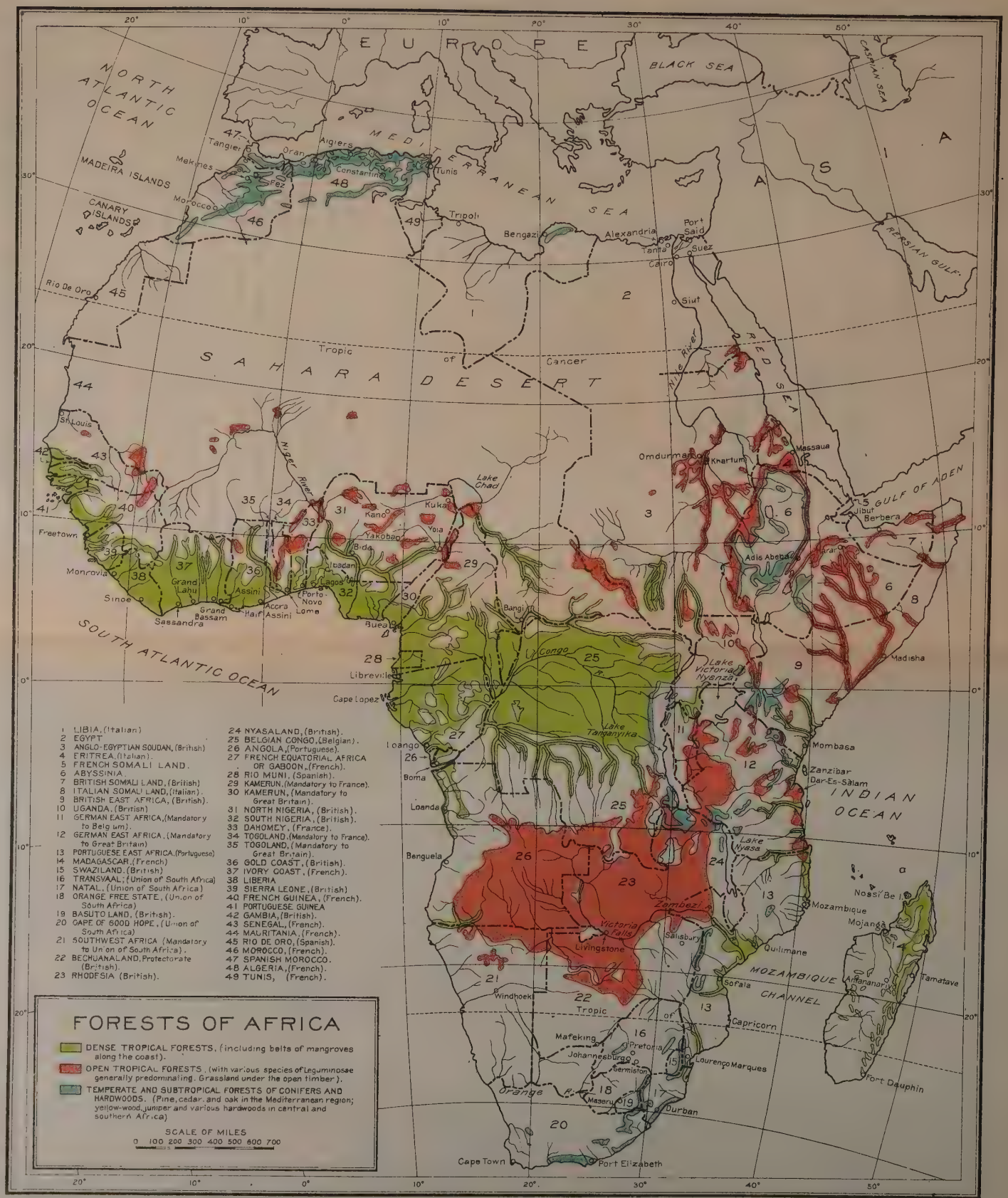

1 LIBIA, (Italian)
2 EGYPT
3 ANGLO-EGYPTIAN SOUDAN, (British)
4 ERITREA, (Italian).
5 FRENCH SOMALI LAND.
6 ABYSSINIA.
7 BRITISH SOMALI LAND, (British)
8 ITALIAN SOMALI LAND, (Italian).
9 BRITISH EAST AFRICA, (British).
10 UGANDA, (British)
11 GERMAN EAST AFRICA, (Mandatory to Belgium).
12 GERMAN EAST AFRICA, (Mandatory to Great Britain)
13 PORTUGUESE EAST AFRICA, (Portuguese)
14 MADAGASCAR, (French)
15 SWAZILAND, (British)
16 TRANSVAAL; (Union of South Africa)
17 NATAL, (Union of South Africa)
18 ORANGE FREE STATE, (Union of South Africa)
19 BASUTO LAND, (British).
20 CAPE OF GOOD HOPE, (Union of South Africa)
21 SOUTHWEST AFRICA (Mandatory to Union of South Africa).
22 BECHUANALAND, Protectorate (British).
23 RHODESIA (British).
24 NYASALAND, (British).
25 BELGIAN CONGO, (Belgian).
26 ANGOLA, (Portuguese).
27 FRENCH EQUATORIAL AFRICA OR GABOON, (French).
28 RIO MUNI, (Spanish).
29 KAMERUN, (Mandatory to France).
30 KAMERUN, (Mandatory to Great Britain).
31 NORTH NIGERIA, (British).
32 SOUTH NIGERIA, (British).
33 DAHOMEY, (France).
34 TOGOLAND, (Mandatory to France).
35 TOGOLAND, (Mandatory to Great Britain).
36 GOLD COAST, (British).
37 IVORY COAST, (French).
38 LIBERIA
39 SIERRA LEONE, (British)
40 FRENCH GUINEA, (French).
41 PORTUGUESE GUINEA
42 GAMBIA, (British).
43 SENEGAL, (French).
44 MAURITANIA, (French).
45 RIO DE ORO, (Spanish).
46 MOROCCO, (French).
47 SPANISH MOROCCO.
48 ALGERIA, (French).
49 TUNIS, (French).

FORESTS OF AFRICA

DENSE TROPICAL FORESTS, (including belts of mangroves along the coast).

OPEN TROPICAL FORESTS, (with various species of Leguminosae generally predominating. Grassland under the open timber).

TEMPERATE AND SUBTROPICAL FORESTS OF CONIFERS AND HARDWOODS. (Pine, cedar, and oak in the Mediterranean region; yellow-wood, juniper and various hardwoods in central and southern Africa)

SCALE OF MILES
0 100 200 300 400 500 600 700

PLATE XV
FORESTS OF AFRICA

(*Facing page 808*)

CHAPTER VII

THE FOREST SITUATION IN AFRICA

THE CONTINENT AS A WHOLE

The total area of the continent of Africa is 7,438,464,000 acres. Timber forests cover 797,500,000 acres, or 10.7 per cent of the total, and woodland, consisting of thorn and brush, 141,331,000 acres, or 1.9 per cent of the total. The area of timber forest is 5.6 acres per capita.

The timber forests may be roughly divided into three large groups:

1. Dense tropical forest.
2. Open tropical forest.
3. Subtropical and temperate forest of conifers and hardwoods.

The dense tropical forest, including mangroves, occupies an area of nearly 382,876,000 acres, or 48.1 per cent of the area of timber forest. The open tropical dry hardwood forest is almost exactly the same in extent, while the subtropical and temperate hardwood and coniferous forests occupy about 30,248,000 acres, or 3.8 per cent of the forest area.

The dense tropical forest is characteristic of the African equatorial region, including Belgian Congo, French Equatorial Africa, Cameroon, Nigeria, the Gold Coast, Ivory Coast, Sierra Leone, Liberia, Portuguese Guinea, and a few other colonies scattered in central East Africa. It is characterized by heavy, uniformly distributed rainfall (from 60 to 160 inches).

The composition of the primary or virgin forest is entirely different from that of the secondary forest, which comes in after the virgin woods have been exploited and usually burned. The secondary forest is made up of rapid-growing, light-needing species, having soft wood, with a luxuriant undergrowth of climbers, lianas, and weed growth forming impenetrable thickets. The most common species which, like aspen and birch of the temperate forests, takes possession of these openings, is umbrella tree (*Musanga smithii*). Its proposed use for wood pulp completes its resemblance to the aspen of the temperate region. *Ceiba pentandra* is another species that is particularly abundant in the secondary forest.

The mangrove forest, which may be considered a part of the dense tropical evergreen forest, although not very extensive in area (only 10,000 square miles), is important commercially. Mangrove is used for ties and other construction purposes where the wood is exposed to the attack of termites and mussels. The principal use of mangrove bark is as tanning material. The east coast furnishes most of the bark, since

there it is easily prepared for market, while on the west coast more humid conditions make this more difficult. The mangrove forests are confined to the swamps in salt or brackish water, mostly at the mouth of rivers and in estuaries. They extend from the Red Sea to Natal on the east coast and from Senegambia to Angola on the west coast. Usually these forests are not extensive and are limited to rather narrow belts along protected portions of the coast, low islands, and the lower saline banks of the rivers.

The open tropical forest varies in density from an open, park-like growth of trees to a comparatively dense stand. It is really a transition from the dense evergreen tropical forests to the woodland type. Many of the species which occur in the tropical rain forest occur here also, as well as several species typical of the woodland forest, such as acacias. The greatest areas are found in the northeastern and southern parts of Africa, especially in Rhodesia, Angola, Uganda, former German East Africa, and British East Africa. This forest is characterized by a rainfall of 30 to 40 inches during the growing season.

Both the dense and the open tropical forests contain many important woods which resemble mahogany, rosewood, ebony, cedar, oak, greenheart, walnut, and pine. As a rule, a number of species furnish wood of similar character. A Bertin classifies the woods of French Equatorial Africa into seven groups, according to their possible use in place of the common conifers and hardwoods of the temperate region:

Group 1. Woods capable of taking the place of the softer woods of the broadleaf species, such as aspen, cottonwood, and yellow poplar of North America (*Liriodendron*). Their weights per cubic foot of dry wood range from 17 to 37 pounds, corresponding to the weights of the woods of the temperate region for which they may be substituted.

Table 342.—West African Woods Similar to Poplar and Aspen

Species	Occurrence	Specific gravity of dry wood
Turraeanthus africana	Ivory Coast	0.600
Canarium velutinum	Gaboon	0.400
Alstonia congensis	Ivory Coast and Cameroon	0.425
Eriodendron guineense	Ivory Coast and Cameroon	0.315
Parkia agboensis	Ivory Coast	0.525
Gambeya afr cana	Gaboon	0.625
Odyendyea gabunensis	Gaboon	0.325
Anthostema aubryanum	Gaboon	0.375
Musanga smithii	Ivory Coast and Cameroon	0.270
Triplochiton scleroxylon	Ivory Coast	0.425

Group 2. Woods capable of replacing pines and spruces of the northern countries. These woods have dry weights of 31 to 41 pounds per cubic foot.

TABLE 343.—WEST AFRICAN WOODS SIMILAR TO PINES AND SPRUCE

Species	Occurrence	Specific gravity of dry wood
Canarium occidentale	Ivory Coast	0.450
Mitragyna macrophylla	Gaboon and Cameroon	0.550
Oxystigma mannii	Cameroon	0.660
Daniella spp	Gaboon	0.500
Vitex pachyphylla	Gaboon	0.500
Terminalia ivorensis	Ivory Coast	0.475
Enantia chlorantha	Cameroon	0.600
Cola proteiformis	Cameroon and Ivory Coast	0.575
Aucoumea klaineana	Gaboon	0.440
Fagara and *Sorindeia*	Gaboon and Cameroon	0.500
Antrocaryon klaineanum	Gaboon	0.500
Scyphocephalium ochocoa	Gaboon	0.550
Poga oleosa	Gaboon	0.425
Pachylobus buettneri	Gaboon	0.625
Sarcocephalus esculentus	Ivory Coast	0.475

Group 3. Woods capable of replacing the different species of oak and teak, having dry weights of 38 to 60 pounds per cubic foot.

TABLE 344.—WEST AFRICAN WOODS SIMILAR TO OAK AND TEAK

Species	Occurrence	Specific gravity of dry wood
Berlinia sp.	Gaboon and Cameroon	0.700 to 0.950
Piptadenia sp.	Cameroon	0.950
Piptadenia africana	Ivory Coast	0.775
Dumoria africana	Gaboon	0.750
Berlinia bracteosa	Gaboon	0.675
Chlorophora excelsa	Ivory Coast, Gaboon, and Cameroon	0.700
Dumoria heckeli	Ivory Coast	0.725
Baillonella toxisperma	Gaboon and Cameroon	0.800
Fagara macrophylla	Gaboon	0.875
Parinarium tenuifolium	Ivory Coast	0.850
Erythrophleum guineense	Ivory Coast, Gaboon, Cameroon.	0.875
Parkia spp	Gaboon and Cameroon	0.700
Terminalia altissima	Cameroon and Ivory Coast	0.610

Group 4. Woods capable of replacing beech, hornbeam, and sycamore, having dry weights of 42 to 46 pounds per cubic foot.

TABLE 345.—WEST AFRICAN WOODS SIMILAR TO BEECH AND SYCAMORE

Species	Occurrence	Specific gravity of dry wood
Maesobotrya stapfiana	Ivory Coast	0.675
Uapaca spp.	Ivory Coast, Gaboon, and Cameroon	0.750

Group 5. Woods capable of replacing elm, ash, and locust, having dry weights of 42 to 46 pounds per cubic foot.

TABLE 346.—WEST AFRICAN WOODS SIMILAR TO ELM AND ASH

Species	Occurrence	Specific gravity of dry wood
Calpocalyx klainei	Gaboon and Cameroon	0.675
Distemonanthus benthamianus	Gaboon and Cameroon	0.750
Piptadenia sp.	Gaboon	0.675

Group 6. Cabinet woods and woods for inlay work, having dry weights of 30 to 56 pounds per cubic foot.

TABLE 347.—WEST AFRICAN CABINET WOODS

Species	Occurrence	Specific gravity of dry wood
Khaya and various *Meliaceae*	Ivory Coast, Gaboon, and Cameroon	0.625
Bridelia speciosa	Gaboon	0.575
Sarcocephalus trillesii	Ivory Coast, Gaboon, and Cameroon	0.775
Trichilia cedrata	Ivory Coast	0.625
Copaifera aff. *arnoldiana*	Gaboon and Cameroon	0.900
Staudtia gabonensis	Gaboon and Cameroon	0.875
Ochrocarpos africana	Ivory Coast and Gaboon	0.775
Pterocarpus soyauxii	Gaboon and Cameroon	0.775

Group 7. Woods suitable for railroad ties, rolling stock, piling, naval construction, and other uses, having dry weights of 46 to 75 pounds per cubic foot.

TABLE 348.—WOODS SUITABLE FOR RAILROAD USE, WEST AFRICA

Species	Occurrence	Specific gravity of dry wood
Petersia viridiflora	Ivory Coast	0.750
Cicca discoidea	Ivory Coast	0.850
Haematostaphis barteri	Ivory Coast	1.050
Desbordesia sp.	Gaboon and Cameroon	1.150
Lophira procera	Ivory Coast, Gaboon and Cameroon	1.075
Avicennia nitida	Cameroon	1.000
Anopyxis occidentalis	Ivory Coast	0.950
Dialium macranthum	Cameroon	0.850
Corynanthe gabonensis	Cameroon	0.850
Coula edulis	Ivory Coast, Gaboon and Cameroon	1.075
Diospyros aggregata	Cameroon	0.975
Diospyros sp.	Gaboon and Cameroon	1.200
Klainedoxa latifolia	Gaboon and Cameroon	1.125
Oldfieldia africana	Ivory Coast	1.075
Klainedoxa sp.	Ivory Coast	1.050
Dialium guineense	Ivory Coast	0.975
Pentaclethra macrophylla	Cameroon	1.000
Sacoglottis gabonensis	Gaboon and Cameroon	1.000
Rhizophora racemosa or *mangle*	Ivory Coast, Gaboon, and Cameroon	1.125
Corynanthe johimbe	Cameroon	0.850

The subtropical and temperate forest may be divided into two distinct regions—one characteristic of the mountain region adjacent to the Mediterranean, in Algeria, Tunisia, and Morocco, and the other characteristic of the high mountains of Central and East Africa.

In the Mediterranean mountain region the tree growth is mostly pine, cedar, and oak. It is of a decidedly temperate character, and is different from other forests in Africa.

In Central and East Africa the deciduous forest of the high mountains or, as it is often called, the "fog" or "cloud" forest, is more or less semi-tropical. It is characterized by conifers, including several species of the so-called African pine or yellowwood (*Podocarpus usambarensis, P. elongata, and P. thunbergii*) and pencil-wood cedar (*Juniperus procera*). In addition, a large number of broad-leafed species of commercial importance are found.

Although the extent of the subtropical and temperate forest is limited, it is important commercially as the only source of coniferous timber in Africa. The oak-cedar type occupies about 14,200,000 acres, or 1.8 per

cent of the forest area of Africa, and the temperate forests of the high mountains of Central and Eastern Africa 16,048,000 acres, or 2.0 per cent.

The woodland is composed of thorn and brush forests. In the former acacias, as a rule, dominate.

Within the desert areas, wherever a supply of fresh water reaches the surface, groves of trees such as date palms, acacias, or species of *Ficus*, *Zizyphus*, and *Tamarix* occur. These oases occur primarily throughout the Sahara Desert.

Except for mahoganies and a few cabinet woods,[1] largely from the West Coast, the principal products of African forests have hitherto been of the nature of by-products—rubber, gums, cork, palm-oil and other vegetable fats, tanning substances, dyewoods, kapok, nuts, fruits, and fibers.

The natives use comparatively little wood—principally for firewood, huts, boats, handles, weapons, a little rough furniture, and fencing. European settlers have brought with them a demand for wood for houses, furniture, vehicles, mine timbers, railroad ties, fuel, and many other things.

Until recent years this demand has been met to a considerable extent by importing wood, especially construction material,—from the Baltic countries, Austria, United States, Australia, India, and other countries. Yet Africa has some 800,000,000 acres of forest with a stand of at least 500 billion cubic feet of saw timber. Except for the mahogany trade, no attempt has been made to exploit this timber in more than a limited local way, and until the last fifteen or twenty years very little was known about the extent or composition of the African forests.

Naturally very little effort has been made until recent years to protect these forests from destruction, or to manage them for growing timber. The greatest enemy of the forest is the native farmer, who clears virgin forest to plant his crops, uses the area a few years, then passes on to a new one. Fires following at frequent intervals destroy the second growth, and gradually convert forest land into open park-like savanna.

The limited forest areas at the two extremities of the continent—in the French colonies on the Mediterranean Coast and in the British colonies at the Cape—led these colonies to put their forests in charge of

[1] The African mahoganies are derived from several botanical genera. The most common is the genus *Khaya*, especially the so-called dry-zone mahogany, *Khaya senegalensis*, African or Rhodesian mahogany (*Afzelia africana*), scented mahogany (*Entandrophragma* spp.), Gaboon mahogany (*Aucoumea klaineana*), *Lovoa*, mostly known as African walnut, and several other genera.

Of the cabinet woods, ebony (*Diospyros*), black stinkwood (*Ocotea bullata*), and black ironwood (*Olea laurifolia*) are the most commonly known.

forest services. A number of others have followed suit, but the work so far seems to have consisted largely of exploration, to find out the extent and quality of the timber.

Just before the war broke out, Great Britain, France, Germany, and Belgium were beginning to turn their attention to the forest resources of their African colonies, with the idea that a considerable proportion of their wood supplies might be drawn from these regions. Investigation disclosed the fact that in South and Central Africa and in the Atlas range in the North there were many valuable species of timber besides the cabinet woods—in fact, timber to fill every need of European industries (except for conifers, of which the supply is rather limited). There are, however, a number of light woods which can probably be used for the purposes for which conifers are in demand.

Some of the reasons why these woods have not found a place on the European markets are:

(a) Ignorance of the character, quantities, and qualities of the different woods.

(b) Lack of any systematic effort to put them on the market and keep them there.

(c) Excessive transportation costs, caused by lack of facilities for getting logs out of the forests and high ocean freight rates to Europe.

(d) High cost of logging in tropical forests—due partly to the practice of culling out trees of one or a few species, instead of taking all the mature timber in the stand.

(e) Lack of modern machinery and equipment for logging and milling, and limited capital of operators.

(f) Abundant supply of cheap woods from other sources.

It is likely that steps will soon be taken to develop African forests. It has even been suggested that France can get most of the wood needed for reconstruction in the war zone from her forests in Gaboon and the Ivory Coast. Some construction material from these sources has already appeared on the French market, and been used for military barracks. On account of its ant-resistant qualities, much of the African timber is greatly superior to northern woods for building in the tropics.

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BELGIAN AFRICA—Congo

Forest Area.—Belgian Congo, which derives the latter part of its name from the largest and most important river system in Africa, also contains the largest compact forest area of the continent. Of the 582,178,560 acres, probably 448,000,000 acres, or 77 per cent, is covered with forests of one kind or another. The area of the great evergreen equatorial forest of Central Africa, however, is approximately only 180,000,000 acres, or 25 times as large as Belgium itself and 30.9 per cent of the total land area. With a population of 10 to 15 million this is 12 to 18 acres per capita. These figures are summarized in Table 349.

Table 349.—Forest Area, Belgian Congo.

Total land area	Population	Forest area		
		Equatorial forest	Per cent	Per capita
acres		*acres*		*acres*
582,178,560	10,000,000 to 15,000,000	180,000,000	30.9	12.0 to 18.0

Character of the Forest.—The forests of Belgian Congo range from mangrove swamps on the islands at the mouth of the Congo River, through the dense evergreen forests of the Upper Congo, to the open deciduous forests or almost treeless areas of Katanga. The equatorial forest is an almost continuous body of forest with comparatively few breaks, and a large proportion of it is virgin forest. Despite the obvious advantage of the Congo River, with 3,000 miles suitable for timber transport, and its hundreds of tributaries with many more thousand miles capable of floating logs, practically no timber has been cut in this forest except for local use.

The equatorial forest is surrounded by savannas which reach the Atlantic coast on the southwest and the Indian Ocean on the east, except for the narrow coastal strip of forest.

Katanga, the southeastern district of the Congo, is largely grass-veldt or brush forest, valuable only for firewood. While there are scattered merchantable trees in the brush, they are too few to be worth cutting except for local use. This district is an important copper region, and will develop agriculturally in the near future.

Annual Growth, Cut, and Consumption.—In view of the virgin condition of most of the forest and the small annual utilization, the net

growth is probably almost nil. Since practically no wood is exported or imported, the annual cut must be the same as the amount consumed. This is estimated to be about 5 cubic feet per capita, or from 50,000,000 to 75,000,000 feet in all. Nearly all of it is firewood.

The railways of the Congo have not been used to any extent for the shipping of timber, though vast quantities of firewood have been burned by them, as well as conveyed to the various stations both near and on the River Congo. The slight development of the lumber industry is due to the fact that with a small, thinly scattered population the working of timber, which is the heaviest product and difficult to transport, is less remunerative than the working of rubber, which has a higher value per unit of weight. Possibly also the system of exclusive trade concessions hinders free development of the lower-priced forest products such as timber.

There are about five sawmills—one on Bertha Island belonging to the Belgian Society; one in the Lukolela district managed by the Marine Service; one of large size in the mountains of Lukolela belonging to the Syndicat d'Entreprises et d'Etudes au Congo; one at Kikwit run by the Compagnie Sedec; and finally, the Railroad of the Grand-Lacs has one which in 1916 sawed up about 10,000 cubic feet of timber.

Exports.—There are practically no exports of wood. Mahogany (*Khaya*) as an export timber is not very well known in Belgian Congo. The better known species are redwood (*Pterocarpus* sp.) and blockwood or boxwood (*Polyadoa umbellata* or *Dialium guineense*). Other forest products, however, such as gum copal (*Daniella* sp.), are found in huge quantities and have been exported for many years. The export of copal in recent years was as follows:

	Tons
1913	4,698
1914	6,993
1915	4,266
1916	8,677

Oil palm products, such as kernels and oil, are of increasing importance, especially since Les Huileries de Congo have started working up the oil palm forests with modern means of transport and machinery, in three different tracts of 30,000 acres each. One of the other products exported is wild rubber, derived chiefly from lianes and grasses. In 1913 the export of rubber amounted to 3,623 metric tons; in 1914, 2,249 tons; in 1915, 2,179 tons; and in 1916, 2,823 tons.

The Congo forests contain large quantities of timber which, while it is not utilizable for wood, is suitable for wood distillation.

Legislation.—Forest regulation distinguishes between the cutting of construction timber and of industrial timber. No one is permitted to

cut construction timber in the state forests for personal use without a permit from the district officer. No one may sell construction timber without a permit for its cutting and sale. The area subject to exploitation cannot be less than 125 nor more than 1,250 acres. All trees less than 35 inches in circumference are reserved. The same regulation with regard to permits applies also to industrial timber, such as is used for bark distillation or charcoal, except that the trees which are to be reserved should be only those which are more than 85 inches in circumference. The owner of private forests who wants to clear his land must declare his intention to the chief of the district.

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BRITISH AFRICA

British colonies and protectorates in Africa include Egypt, Anglo-Egyptian Sudan, British Somaliland, British East Africa, Uganda, Zanzibar, Nyasaland, Rhodesia, Bechuanaland, Basutoland, Swaziland, Union of South Africa (Transvaal, Orange Free State, Natal, and Cape of Good Hope), Nigeria, Gold Coast (Ashanti), Sierra Leone, and Gambia.[1] These colonies, with a total area of over 2 billion acres and a population estimated at 52,452,000, have about 350,000,000 acres of forest land, besides considerable areas of scrub which furnishes a good deal of firewood and other material for local consumption.

Of the British colonies in Africa, Nigeria and the Gold Coast can be counted on to export considerable amounts of timber. Several other colonies, such as Gambia, Sierra Leone, East Africa, and Uganda, have more than enough for immediate needs, but not a sufficient surplus to export lumber, when future growth in white population and industry is considered. South Africa imports large quantities of lumber now, but hopes eventually to be able to produce enough for its own needs. The other colonies will probably need to import lumber in considerable amounts as they become settled. Egypt has imported nearly all her lumber and some of her firewood for many years.

Table 350 gives a summary of the forest situation in British Africa, exclusive of the former German colonies which came under British control as a result of the war.

[1] Besides several islands not considered here.

TABLE 350.—FOREST SITUATION IN BRITISH AFRICA

Country	Total land area	Population	Forest area			Productive forest area			Exports	Imports	Difference[1]
			Area	Per cent	Per capita	Area	Per cent	Per capita			
	acres		*acres*		*acres*	*acres*		*acres*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*
Basutoland	7,498,240	404,500	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bechuanaland	176,000,000	125,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
British East Africa	156,838,400	2,656,771	3,264,000	2.1	1.20	2,304,000	1.5	0.90	327	160	+167
British Somaliland	43,520,000	300,000	500,000	1.1	1.70	500,000	1.1	1.70	.....	.....	.....
British West Africa:											
Gambia	2,880,000	200,000	130,000	5.0	0.65	130,000	5.0	0.65	.....	.....	.....
Gold Coast and Ashanti	51,200,000	1,500,000	24,390,400	47.6	16.30	8,960,000	17.5	6.00	1,384	346	+1,038
Nigeria (Northern, Southern and Lagos)	215,040,000	17,250,000	139,776,000	65.0	8.00	32,256,000	15.0	1.90	.....	.....	.....
Sierra Leone	21,760,000	1,400,000	218,000	1.0	0.16	218,000	1.0	0.16	10	210	−200
Egypt and Anglo-Egyptian Sudan	873,216,000	16,150,000	7,000,000	0.8	0.40	7,000,000	0.8	0.40	.....	24,412	−24,412
Nyasaland	27,909,120	1,138,000	280,000	1.0	0.25	280,000	1.0	0.25	.....	.....	.....
Rhodesia:											
Northern	186,240,000	890,000	111,744,000	60.0	125.60	22,348,000	12.0	25.10	.....	.....	.....
Southern	97,600,000	838,284	58,560,000	60.0	70.00	11,712,000	12.0	14.00	34	258	−224
Seychelles	99,840	25,000	5,000	5.0	0.20	5,000	5.0	0.20	.....	.....	.....
Swaziland	4,273,920	100,000	1,088,000	25.0	10.90	1,088,000	25.0	10.90	.....	.....	.....
Uganda	59,354,880	3,361,000	896,000	1.5	0.27	896,000	1.5	0.27	.....	.....	.....
Union South Africa	302,781,440	6,000,000	1,511,040	0.5	0.25	1,511,040	0.5	0.25	43	19,500	−19,457
Zanzibar	409,600	113,600	9,000	2.2	0.08	9,000	2.2	0.08	.....	.....	.....
Total	2,226,621,440	52,452,155	349,371,440	15.7	6.70	89,217,040	4.0	1.70	1,798	44,886	−43,088

[1] + Exports exceed imports; − imports exceed exports.

Basutoland and Bechuanaland

These colonies are to a large extent covered with open grass veldt or thorn bush. Fringes of forests are found along the larger streams. These regions will probably always have to depend on the outside for construction, mining, and railroad timbers, as the demand for such material develops. In Basutoland there are a few plantations of exotics, such as pines and eucalypts, near the principal settlements.

British East Africa (Kenya Colony)

Forest Area.—British East Africa has an area of 156,838,400 acres and a population estimated at 2,656,771. The total forest area has been estimated at 3,264,000 acres, or 2.08 per cent of the land area. Of the forest area only 2,304,000 acres is considered as merchantable, the remaining 960,000 acres being either inaccessible or unprofitable at the present time. The merchantable forests occupy 1.47 per cent of the total land area. The per capita forest area is 1.2 acres and the per capita merchantable forest area is 0.9 acre.

Character of Forest.—The forests of British East Africa fall into eight natural types, determined by their geographical location and the species composing them. These are: (1) mangrove forests, situated along the coast on creeks and inlets; (2) coast forests proper, which formerly covered large areas but have to some extent been cleared for agricultural purposes; (3) "nyika" forests, situated in arid regions and forming almost impenetrable thickets and dense regular forest near the coast; (4) plateau forests, growing at an altitude of 5,000 to 6,000 feet; (5) mountain forests, which make up by far the greater part of the forests of the Protectorate; (6) muzaiti forests, composed of vigorous dense vegetation of many kinds; (7) cedar forests, the most important commercially, and consisting largely of the only two coniferous timber species of the country, cedar (*Juniperus procera*) and podo (*Podocarpus gracilior* and *P. milanjianus*); and (8) the bamboo zone, which extends from 7,500 to about 10,000 feet above sea level.

Some of the principal timber trees of the protectorate, with their properties, location, and uses, are as follows:

Afzelia cuanzensis.—Mbemba kofi. Coast and nyika forests. Wood heavy, red, polishes well, ant-resistant. Doors, frames, furniture, etc.

Allophylus abysinnicus.—Mushami. Muzaiti forests. Wood light, fairly hard, works and polishes well. Furniture, paneling, ceiling.

Brachylaena hutchinsii.—Muhugu. Plains forests. Wood very hard, works and polishes well. Very durable. Ant-resistant. Fence posts, piles, flooring, fuel.

Brachylaena sp.—Muhuhu. Nyika forests. Widely distributed.

Suitable for exposure to weather. Smaller than *B. hutchinsii;* otherwise similar.

Dombeya mastersii.—Mukao. Cedar forests. Small tree, wood light and tough, not durable. Packing cases, etc.

Juniperus procera.—Cedar. Cedar forests. Very widely distributed. Wood light, soft, works and polishes well. Liable to crack. Durable, ant-resistant. Pencils, flooring and ceiling boards, fence posts, etc.

Ocotea usambarensis.—Muzaiti. Muzaiti forests. Very large. Limited distribution. Wood light, soft, works easily, polishes well, liable to warp. Durable, ant-resistant. Substitute for teak. Railway carriage paneling.

Olea hochstetteri.—Musharage. Cedar and muzaiti forests. Large, widely distributed. Wood hard, heavy, liable to crack and warp. Durability not known. Saws, planes, and polishes well. Railway ties, wheel spokes, furniture, etc.

Podocarpus gracilior.—Podo. Cedar forests. Not very widely distributed. Coniferous wood, soft, light, works well, not durable. Inside building, flooring, joinery, plain furniture.

Pygeum africanum.—Bueri. Muzaiti and cedar forests. Wood heavy, dense, very tough, not easy to work. Bolster beams, railway trucks, wheels, all uses requiring great strength.

Character of Ownership.—The state retains the ownership of nearly all the forests and forest lands of the protectorate. Out of the total area of 3,264,000 acres, 3,200,000, or 98.04 per cent, belongs to the state, and 64,000, or 1.96 per cent, belongs to private individuals. Of the 3,200,000 acres of state forests, 1,408,000 acres, or 44 per cent, is dedicated permanently to timber production, while the remaining 1,792,000 acres, or 56 per cent, consists of other state forests not devoted to permanent forest production.

Annual Growth.—The total growth over the 1,408,000 acres of state forests devoted to permanent timber production is estimated at 28,160,000 cubic feet. The few privately owned forests are being destroyed so fast that they can be left out of consideration entirely as timber-producing areas. The loss through fire, waste, and decay is figured at 1 per cent of the growth, or 281,600 cubic feet. The net increment is therefore placed at 27,878,400 cubic feet per acre of permanent state forests.

Annual Cut.—There are no figures for the cut in private forests. Since the state forests form the bulk of the forests, however, the cut given for them is probably almost the total cut of saw timber. The annual cut is 456,087 cubic feet of timber and 2,931,993 cubic feet of fuelwood, or a total of 3,388,080 cubic feet. Timber thus forms 13.5 per cent of the entire cut. The average cut per acre in state forests is 1.5 cubic feet. In addition about 10,064,000 cubic feet of firewood may be cut, making a total cut of 13,452,000 cubic feet.

Annual Cut and Growth Contrasted.—With a utilization of 13,452,080 cubic feet and a net increment of 27,878,400 cubic feet, it is evident that there is a large surplus of timber over and above the home demand which should be available for export. Since the logging is concentrated in the forests lying near the railroads, however, the cut in those forests exceeds the growth and may cause a shortage of timber there.

Exports and Imports.—The average annual exports for the 6-year period 1914-19 amounted to 327,421 cubic feet, while the imports for the same period amounted to 159,642 cubic feet. Thus exports exceed imports by 167,779 cubic feet. The exports consist largely of mangrove poles for the Persian Gulf and south Arabian ports. The export of mangrove poles amounts to 320,471 cubic feet, valued at $51,676, while the export of all other timber is only 6,950 cubic feet, valued at $6,026. The export of timber other than mangrove poles has not assumed much importance in the trade of the country. Imports are rapidly increasing, and consist chiefly of coniferous woods from Scandinavia and the west coast of America. Some teak is also imported from Burma. It is of interest to note that the total value of timber exports is $57,702, while the value of imports is $81,284. In other words, although the quantity of exports is greater than the quantity of imports, the value of imported timber is greater than the value of that exported. This adverse balance between the values of exports and imports is due to the low values of mangrove poles and the higher values of the softwoods and teak imported.

Domestic Consumption.—The total domestic consumption, allowing for exports and imports, is 13,284,301 cubic feet, or 5 cubic feet per head of population. If we deduct the fuelwood, 12,995,995 cubic feet, the home consumption of native and imported construction timber is only 288,306 cubic feet, or 0.11 cubic foot per head of population, a remarkably low consumption.

Forest Industries.—Forest industries in the protectorate are limited to timber sawing and cutting of fuelwood. The number of natives employed is estimated at approximately 2,500, and 78 Europeans are also employed. An industry which may undergo considerable development in the near future is the manufacture of paper pulp from bamboo.

Forest Laws.—Forest legislation in the colony consists of an ordinance, passed in 1911, and various amendment ordinances and rules. The ordinance of 1911 provides that a board of forest commissioners consisting of five members shall be formed, and also states that the Governor may proclaim any area a forest area, but neither of these measures has been applied. The rules and amendment ordinances fix penalties for misdemeanors and state conditions for removing forest products, grazing, etc.

The efforts of the small administrative staff of the forests of British East Africa are directed to conservation and protection of the forests, exploitation of the forest products, and regeneration and planting. Exotics are grown in nurseries and sold to planters and settlers. These are rapidly growing trees, chiefly eucalypts and cypress, and *Grevillea robusta*.

Revenue.—Table 351 shows the revenues and expenditures during the five-year period 1914–19.

TABLE 351.—REVENUES FROM STATE FORESTS, BRITISH EAST AFRICA.

	1914–15	1915–16	1916–17	1917–18	1918–19
Expenditure	$52,512	$48,590	$49,402	$50,748	$63,020
Revenue	34,331	35,964	55,205	58,223	57,887
Ratio of revenue to expenditure (per cent.)	65.38	74.02	111.75	114.73	91.85

Forest Education.—No instruction in forestry is provided in the protectorate. There is no forest research laboratory. Some local experimental work is conducted by the Department of Forestry in connection with its regular work.

Probable Future.—Taking the country as a whole, the growth now exceeds the cut, except in forests lying near the line of the Uganda Railway. There, because of overcutting and lack of natural reproduction, the cut exceeds the growth. The result will be a temporary timber shortage in those forests, as they were the first to be exploited and have been drawn upon to supply fuel for the railroad.

As settlement spreads and other railways are constructed, the forests which are now inaccessible will be exploited. Furthermore, oil fuel is coming more and more into use by railroad locomotives and will release a large quantity of timber for more valuable purposes than firewood. With better care and management of the forests, the country may not only become self-supporting as regards its timber demands but also may have large quantities of timber for export.

British Somaliland

Forest Area.—The area of British Somaliland is 43,520,000 acres; the population about 300,000. The greater part of the country is covered with tall grass or thick thorn bush, with occasional isolated trees of the acacia or related families. The forest area is estimated at about 500,000 acres, 1.1 per cent of the land area, or 1.7 acres per inhabitant.

Character of the Forest.—The only forest of commercial value is an inaccessible growth of mountain cedar on the uplands of the Golis mountain range, at an altitude of about 9,500 feet. Mountain cedar reaches a height of 100 feet. The remaining timber, while fairly abundant in some places, is small and suitable only for fuel and industrial uses not requiring large dimensions, such as posts, frames, and possibly railroad ties. The local consumption of wood is not large.

Gambia

Forest Area.—Gambia has a land area of about 2,880,000 acres. This includes both the colony proper and the Protectorate. Forests, in the ordinary sense of the word, do not exist in Gambia. A considerable amount of timber, however, could still be obtained from the dry zone country, or savanna forest. Part of the land near the mouth of the Gambia River is swampy and covered with the usual mangrove forests. The forest area is probably in the neighborhood of 130,000 acres, or 5 per cent of the land area. With a population of 200,000 this means 0.65 acre per inhabitant. The tree most useful at present is the oil palm, which yields palm oils and kernels. The oil is used locally, but the palm kernels are exported to the amount of about 500 tons a year.

Imports and Exports.—So far, only rosewood (*Pterocarpus erinaceus*) and mahogany (*Khaya senegalensis*) have been exported from Gambia. In the early part of the 19th century a considerable quantity of African mahogany, obtained from *Khaya senegalensis*, a dry-zone mahogany tree, was shipped to England. In fact, this was the original source of African mahogany. At the present time no mahogany is being exported from Gambia.

Forestry Movement.—There is no forest department in Gambia and no proposals for forest reserves have been put forward by the government, although such reserves should be made, particularly on land that is unsuitable for agriculture. Recently an ordinance was passed regulating the cutting of firewood and forest trees.

Gold Coast

Forest Area.—The Gold Coast stretches for 334 miles along the Gulf of Guinea between the French Ivory Coast and Togoland. It comprises the Gold Coast Colony proper, Ashanti, and the Northern Territories, the aggregate area of which is 51,200,000 acres. The population is 1,500,000. The total forest area is 24,390,400 acres, or 47.6 per cent of the land area and 16.3 acres per capita. Of this, 9,670,400 acres is found in the Colony proper, 8,320,000 in Ashanti, and 6,400,000 in the Northern Territories. Of the 24,390,400 acres of forest, 8,960,000 is classed as merchantable and 15,430,400 as unprofitable or unmer-

chantable forest. The merchantable forest is found entirely in the Colony and Ashanti.

Character of the Forest.—The forests of the Gold Coast are of three main types:

1. Rain or evergreen forest.
2. Monsoon or mixed deciduous forest.
3. Savanna forest.

The rain or evergreen forest and the monsoon or mixed deciduous forest are dense and tropical, while the savanna forest is park-like in appearance.

Some of the characteristic species are as follows:

Entandrophragma (cedar).—The timber is often exported as mahogany. Six varieties have been identified. The tree occurs in the evergreen and also occasionally in the deciduous forest.

Khaya (mahogany).—African mahogany, of which two varieties (*Khaya caudata* and *Khaya ivorensis*) are exported. The species is most plentiful in the western part of the Colony and Ashanti, but is also found less commonly in other parts. It was exported in ever increasing quantity from 1891 to 1914; and at present, owing to the high price in the European markets, the industry is flourishing. Although the tree attains very large dimensions, the average volume of the bole is about 200 cubic feet.

Lovoa klaineana.—A very large tree, found occasionally in the evergreen forests.

Chlorophora excelsa (odum).—One of the largest and most valuable timber trees, distributed throughout the Colony and Ashanti. It has not been exported, as it is in great demand in the country for furniture and building material. It occurs in both the evergreen and the deciduous forest.

Afzelia africana (papao).—A useful timber tree found in the deciduous forests and very plentiful in the savanna forests of northern Ashanti. It is not more than 50 feet in height, with a large spreading crown, while the bole seldom exceeds 25 feet.

Albizzia brownii.—A medium-sized tree, yielding good timber, which is very plentiful in the deciduous forests of the Colony and Ashanti.

Cylicodiscus gabunensis.—A large tree found throughout the deciduous forests of Ashanti and the Colony. It has been exported as greenheart.

Erythrophloeum micranthum.—A large tree found in the evergreen forests. It has reddish-brown bark and is irregular in growth; the timber is said to be of good quality. It is also reported to be poisonous, and there is a report that some girls in Lancashire cotton mills were poisoned by licking spindles made of this wood.

Piptadenia africana (African greenheart).—A large tree very common throughout the Colony and Ashanti, but reaching its optimum in the moist evergreen forests. The timber is of good quality and is known as greenheart.

Xylia evansii.—A medium-sized tree very common throughout the Colony and Ashanti. It yields good timber for local use.

Anopyxis ealaensis.—One of the predominant large trees of the evergreen and deciduous forests. The timber is reported to be good, and is commonly used as fuel.

Heritiera utilis.—A large timber tree found commonly throughout the southwest part of the Colony. Occasionally exported as mahogany and perhaps accepted as such.

Triplochiton johnsoni.—One of the largest and most widely distributed trees in the deciduous forest. The timber is used locally and is not highly valued, but if its usefulness for any particular purpose could be established the supply is practically unlimited.

Lophira procera.—A large tree of frequent occurrence in the moister parts of the evergreen forest, and not found in Ashanti. Its timber is very heavy and hard, but owing to its high calorific property is much valued as firewood.

Mimusops.—One of the largest trees found in the Colony and Ashanti. The timber is of good quality and is often shipped as mahogany.

Borassus flabellifer.—Fan palm is found in a narrow strip along parts of the coast outside the forest zone; it attains its optimum in the savanna forest of northern Ashanti and in the east of the Colony. The valued "ago beam" for buildings is obtained from this tree.

Character of Ownership.—There are no forests belonging to the state. All land is owned by communities as communal or "stool" lands.

Annual Growth.—The annual growth for the 8,960,000 acres of merchantable forests is estimated at 448 million cubic feet. The waste due to fire, decay, and other causes is placed at 5 per cent of the gross growth, or 22,400,000 cubic feet. This leaves a net growth per year for the area of merchantable forests of 425,600,000 cubic feet, or 47.5 cubic feet per acre.

Annual Cut.—The annual cut may be estimated approximately from the data in Table 352.

TABLE 352.—ANNUAL CUT, GOLD COAST.

	Tons		*Cu. ft.*
Export (chiefly mahogany)—average for 10 years			1,383,500
Consumption of fuel by mines	165,500	=	8,275,000
Consumption of timber by mines			315,500
Consumption of fuel by railways	14,500	=	725,000
Consumption of timber (approximately) by public works department and private firms for buildings and bridges			200,000
Total			10,899,000

This does not represent the entire cut, for the natives must also consume a large quantity of fuel wood, amounting to more than 5,000,000 cubic feet, besides a small amount of larger timber. The total cut is estimated at about 16,000,000 cubic feet, of which about 83 per cent is firewood.

Exports and Imports.—The exports on an average for 10 years, 1909-18, amounted to 1,383,500 cubic feet. The imports were 346,200 cubic feet, an excess of exports over imports of 1,037,300 cubic feet.

The export trade in timber is entirely in the mahogany species (*Khaya* and *Entandrophragma*). It began in 1891, when 112,000 cubic feet was exported. For the period 1891–1907 the average annual export was 600,000 cubic feet. The highwater mark was reached in 1913, when over 3 million cubic feet was exported.

About 75 per cent of the imports was obtained from the United Kingdom, the United States of America, and, prior to 1914, from Germany, in equal quantities. The remaining 25 per cent of the imports came from the Canary Islands, France, Belgium, Holland, and the West African colonies.

The average annual export of minor forest products during the years 1909-18 was approximately as follows:

Rubber (tons)	1,000
Palm kernels (tons)	9,000
Palm oil (gallons)	1,000,000
Kopra (tons)	650
Kola (tons)	35,000

Domestic Consumption.—On the basis of the reported cut, the total home consumption, allowing for exports and imports, is 862,000 cubic feet of timber and 9 million cubic feet of fuel. With a population of about a million and a half this would represent a per capita consumption of 0.6 cubic foot of timber and 6 cubic feet of fuel. This is misleading, however, as no account is taken of the consumption of wood by the natives for domestic use. The large areas of forest allocated to agriculture are sufficient to meet the demand indefinitely and are being drawn upon by the natives. Although the actual domestic consumption is not known, it must be considerable. Even at 10 cubic feet per head of population the total consumption would amount to 15,000,000 cubic feet, of which 91.3 per cent would be firewood.

Secondary Forest Products.—The principal forest products other than timber are:

Rubber. Obtained from the tree *Funtumina elastica* and from the vine *Landolphia.* Both the tree and the vine are found throughout the

Colony and Ashanti, except in the savanna forests. A *Funtumia* tree yields on an average four ounces of dry rubber per annum, but as the natives invariably adulterate the pure latex with that obtained from *Alstonia congensis, Chlorophora excelsa, Conopharyngia* sp., *Ficus* spp., or *Funtumia africana,* the quality of the exported article is both impure and variable. The extent to which *Funtumia elastica* and *Landolphia* are found in the forests can be gauged from the fact that in the past export has reached six million pounds per annum. The export in 1918 was only 1 1-3 million pounds, and is very much less now as the natives have no time to attend to any product other than cocoa.

Palm oil and kernels. Obtained from *Elaeis guineensis.* The export of both oil and kernels has also suffered from neglect of the natives who have concentrated on producing cocoa. In 1902 the export was 17,000 tons of kernels and 4,500,000 gallons of oil. In 1918 it was less than 9,000 tons of kernels and only 671,000 gallons of oil.

Kola. Obtained from *Cola acuminata,* which is found wild and to some extent cultivated throughout the Colony and Ashanti. The market for kola nuts is principally Northern Nigeria and to a much less extent the Northern Territories of the Gold Coast. In 1918 about 6,000 tons was exported.

Copra. Obtained from *Cocos nucifera.* The export varies considerably. In 1917 more than 700 tons left the country, whereas in 1918 the amount was only 99 tons.

Shea butter. Obtained from *Butyrospermum parkii.* This species is found in the savanna forests of Northern Ashanti, and more extensively in the Northern Territories where thousands of square miles are more or less covered with it. At present shea butter is used only locally, but there should be a great future for it when railway and motor roads open up the country.

Forest Laws.—Forest laws are still in the process of being drafted, but there is hope that legislation will soon be enacted. It will deal chiefly with regulation of the mahogany export trade, which so far has been carried on in a very haphazard manner. It will also authorize the establishment of forest reserves. These will be managed by a forest department, which is also in the process of organization.

Probable Future.—With an annual cut of 16,038,000 cubic feet and a net growth of 425,600,000, it is evident that the growth exceeds the cut by 409,562,000 cubic feet. The outlook for a future supply from the Gold Coast is very satisfactory. With provisions for a diameter limit for cutting mahogany, which is the chief export timber tree, and with proper measures for its regeneration by artificial means, its export can continue indefinitely on the present scale.

Nigeria

Forest Area.—The Protectorate of Nigeria (North and South Nigeria) is the largest of the British West African possessions. The total land area is about 215,040,000 acres and the population 17,250,000. The forest area is 139,776,000 acres or 65 per cent of the total. Agricultural land occupies 64,512,000 acres, or 30 per cent, and unclassified land 10,752,000 acres, or 5 per cent. The per capita forest area is 8 acres. Of the 139,776,000 acres of forest, 32,256,000 acres, or 15 per cent of the land area, is classified as merchantable, and 107,520,000 acres, or 50 per cent of the land area, as unprofitable or inaccessible forest. The merchantable forest thus forms only 1.9 acres per head of population.

Character of the Forest.—The forests are subdivided into five main types:

1. The mangrove forest along the tidal shores of the coast, which consists mainly of *Rhizophora racemosa, R. mangle* and *Avicennia africana,* and is inundated at high tide with salt water.

2. The tropical rain forest. This is confined to the zone of heavy rainfall with showers even in the driest months, and extends in a belt 50 to 100 miles wide along the coast. Some of the most valuable timber trees of the country are found in this type. They are:

Mahoganies, consisting of various species of *Khaya;* "scented" mahoganies, consisting of various species of *Entandrophragma;* iroko or African teak (*Chlorophora excelsa*); "walnut" (*Lovoa klaineana*); "cedars" (*Gaurea thompsonii* and other species); opepe (*Sarcocephalus esculentus*); pearwood (*Mimusops d'Jave*); African or Rhodesian mahogany (*Afzelia africana*); *Sacoglottis gabonensis;* silk rubber (*Funtumia elastica*); and oil palm (*Elaeis guineensis*). The latter species is the most valuable economically of any tree of the West Coast of Africa.

3. The monsoon, or mixed forest. This type is found in the zone where a fairly heavy annual rainfall is followed by a well-defined dry season. The most important trees are: yellow satinwood (*Afrormosia laxiflora,* afrara (*Terminalia superba*), arere (*Triplochiton johnsoni*), *Piptadenia africana,* and mahoganies such as *Khaya anthotheca* and *K. punchii.*

4. The savanna, or open deciduous forest. This is a park-like forest in which grasses predominate. The principal species are: the valuable shea butter tree (*Butyrospermum parkii*), "dry zone" mahogany (*Khaya senegalensis*), "dry zone" cedar (*Pseudocedrela kotschyi*), "dry zone" ironwood (*Lophira alata*); and fan palm (*Borassus aethiopica*).

5. The thorn forest. As one proceeds northward toward the Sahara, the savanna forest gives place to this type. It consists mainly of several species of acacia, such as *Acacia verek* (yields a valuable gum),

A. seyal (yields gum), *A. arabica,* and *A. sieberiana,* and is replaced by low, thorny scrub just before the sand dunes commence.

In a general way, about 10 per cent of the total area of the country is occupied by rain forest, 2 per cent by mangrove swamp, 8 per cent by monsoon forest, and 45 per cent by savanna forest. The remainder of the country, except for an undefined area of thorn forest, is agricultural or fallow land, scrub, desert, and water.

The timber trees of Nigeria are divided into four classes according to their economic value and the protection afforded them by the Forest Department. These classes, with the characteristics and uses of the species, are as follows:

TABLE 353.—IMPORTANT TIMBER TREES OF NIGERIA.

FIRST CLASS

Khaya spp. (mahoganies). Rain and monsoon forests.
Entandrophragma spp. (scented mahogany). Rain forest.
Gaurea thompsonii and other spp. (cedars). Rain forest; good timber.
Lovoa klaineana. Rain forest; saws and planes well; doors, etc.
Sarcocephalus esculentus. Valuable wood, hard, easy to work, durable.

SECOND CLASS

Mimusops d'jave. Very large. Rain forest. Plain furniture.
Afzelia africana. Mixed deciduous forests. Large tree, valuable wood. Saws easily, but does not plane well. Doors, general carpentry.
Lophira procera. Swamp and rain forests. Wood hard, even-grained; saws and planes well. Valuable for uses requiring strength.

THIRD CLASS

Pterocarpus tinctorius (camwood). Furniture; red dye.
Pterocarpus osun (barwood). Furniture.
Khaya senegalensis (dry zone mahogany). Good mahogany; small sizes.
Erythrophleum guineense and *E. micranthum* (sasswood). Hard, durable; bridge building.

FOURTH CLASS

Terminalia superba, very tall and straight, generally useful for joining.
Mitragyna macrophylla, large, reddish, soft timber, planes and saws well, good for general uses.
Sacoglottis gabonensis, hard, suitable for all building work.
Two Rhizophora species, or red mangroves, excellent for fuelwood.

Character of Ownership.—Practically all of the forests belong to the native tribes and communities of Nigeria. There is no individual ownership. About 2,012,160 acres has been set aside as forest reserves. These are in part government property or are reserved by agreement with the chiefs of the tribes. All forest reserves are under state control and management irrespective of the actual ownership, which frequently rests with the native communities. According to ownership, therefore,

the forests of Nigeria may be divided into state forests (2,012,160 acres, or 1.43 per cent), and communal forests (137,763,840 acres, or 98.56 per cent).

Annual Growth and Cut.—There are no statistics as to the annual growth, cut, and consumption.

The figures available for annual cut are not in cubic feet, but are in the form of number of trees cut (Table 354).

TABLE 354.—ANNUAL CUT, NIGERIA.

Kind of product	Quantity		
	1917	1918	1919
	Trees	*Trees*	*Trees*
For export	1,304	4,244	2,500
Under state control:			
For government exploitation	806	3,031	3,325
Mangrove	2,802	2,800	3,006
For local use	5,328	14,281	16,722
Total	10,240	24,356	25,553

The cubic contents of the timber cut is kept only in the case of trees cut by the government. The figures for the latter are as follows:

	Cu. ft.
1917	182,300
1918	278,491
1919	325,106

On the basis of these figures we may assume 100 cubic feet as the average content of a tree. The total cut in 1917 may therefore be placed at 1,024,000 cubic feet; in 1918, 2,435,600 cubic feet; and 1919, 2,555,300 cubic feet. This represents an average of about 2,005,000 cubic feet, or 0.06 cubic foot per acre of merchantable forests. This is evidently only saw-timber. The cut of firewood is estimated at 84,245,000 cubic feet, making the total cut 86,250,000 cubic feet.

Considering that nearly half of the entire forest is savanna forest, the potential growth or yield may be placed about 50 cubic feet per acre, or 1,612,800,000 cubic feet for the entire area. The actual growth, however, probably does not exceed the cut.

Exports and Imports.—The figures for exports and imports are incomplete, especially with regard to the quantities of the various kinds

of timber exported and imported. A rough approximation of the quantities of timber imported annually is as follows:

Year	Cu. ft.	Value
1912	547,200	$332,137
1913	1,824,400	292,188
1918	877,700	110,259
1919	596,000	200,188

The corresponding approximate figures for the exports are:

Year	Cu. ft.	Value.
1912	1,245,200	$379,892
1913	1,532,200	517,449
1918	68,700	333,717
1919	681,300	568,746

As far as quantity is concerned, in some years the imports exceed the exports and in others the exports exceed the imports. They may be considered as compensating each other. The value of the timber exported and imported shows that the exports, on the whole, exceed the imports. This is probably due to the fact that the chief exports consist of precious woods, such as mahogany and ebony logs, and of furniture made of them. The imports are largely from countries of the temperate region, such as the United States of America, Canada, Norway, Sweden, and Germany, and consist evidently of coniferous timber. The exports go largely to the countries from which the coniferous timber is imported.

Domestic Consumption.—Assuming that the exports and imports balance in quantity, the total cut of 2,005,000 cubic feet may be considered as the domestic consumption. This represents a per capita consumption of 0.1 cubic foot, most of which must be in the form of timber. This evidently does not include the consumption of firewood, which probably brings the total consumption up to 5 cubic feet per person, or 86,250,000 cubic feet.

Wood-Using Industries.—The only forest industry is logging and lumbering of woods for local use or export. The trees logged at present are mahoganies (several species of *Khaya*), "scented" mahogany, (*Entandrophragma*), cedars (*Gaurea*), African walnut (*Lovoa*), and

iroko, "African teak" (*Chlorophora excelsa*), which are exported. The Forestry Department logs the timber needed for government use. The logging is done by companies which are granted a timber license giving them the exclusive right to take trees on a definite area. Most of the work of cutting, hauling, etc., is done by native contractors. The timbers most in demand locally by the Public Works Department are obtained from iroko (*Chlorophora excelsa*), opepe (*Sarcocephalus esculentus*), abura (*Mitragyna macrophylla*), afara (*Terminalia superba*), ekki (*Lophira procera*); and sasswood (*Erythrophleum guineense* and *E. micranthum*).

By-Products.—Of other forest products by far the most valuable are obtained from the oil palm (*Elaeis guineensis*). This produces both the palm oil and palm kernels of commerce and also provides the natives with palm wine. Other palms are *Raphia vinifera*, producing "piassave" and also a palm wine, and the fan palm (*Borassus aethiopica*), the stem of which when split up makes a very strong and durable rafter, much used in native houses.

The production of rubber from *Funtumia elastica* and the rubber vines (*Landolphia* spp. and *Clitandra* spp.), is decreasing in quantity, owing to overtapping of the wild trees and vines by the natives.

Forest Laws.—The forestry ordinance passed in 1916 gives the Governor authority to appoint forestry officers, designate lands as forest reserves, acquire forest lands, protect forests, and collect fees and taxes. "Protection" trees are those for which a minimum felling girth—3 to 11 feet—is fixed by law. Management and protection of forests by the colonial government extends to forests owned by native communities, but while its control is broad, it is under restrictions in the matter of setting aside forest reserves, which usually cannot be done without the consent of the native owners. The ordinance provides for fire protection.

No waste lands have been planted, because of lack of adequate personnel. Some replanting has been done on cut-over areas, and the scope of this work is being broadened.

Revenue.—The expenditure of the Forestry Department amounted in 1919 to $133,213, and the revenue to only $100,991, which indicates a deficit of $32,222. The investment of the government, however, in the logging of timber needed for public works showed a considerable profit. Thus while the government expended $85,356 on timber exploitation, the value of the timber actually delivered was estimated at $145,800.

Probable Future.—If the native system of "shifting cultivation" could be curtailed or stopped, at the present rate of cutting the supplies of timber are probably sufficient for an indefinite period. The probability is, however, that the present rate of cutting will be much exceeded in the near future. In that case, unless many of the less important and

durable timbers are exploited, the supplies of the more valuable kinds will diminish.

Sierra Leone

Forest Area.—The Colony and Protectorate of Sierra Leone cover an area of about 21,760,000 acres. Originally the whole territory was covered with some kind of forest, ranging from open savanna and deciduous forest to dense, impenetrable, evergreen rain forest. There now remains scarcely more than 218,000 acres, or 1.0 per cent. With a total white and native population of about 1,400,000, this makes 0.16 acre per inhabitant. Of the few forest tracts remaining, one of the most important is the Sierra Leone, or Peninsula Mountain forest on the mountain due east of Freetown. The whole of this region was once covered with trees, but the forested area has now been reduced to approximately 38,400 acres. Other important mountain forests are those situated on the Kassewe Hills, Kagnari Mountains, Kambui Hills, Panguma Hills, Nimmini Mountains, Loma Mountains, Bunbola Hills, and Maramper Hills. There are some timbered areas also in the Kangahan and Yonni districts which are largely used locally.

Character of the Forest.—The forests of Sierra Leone, like those of the Gold Coast, are of three main types:

1. Savanna forest. A park-like or dry zone forest.
2. Monsoon or deciduous forest.
3. Evergreen dense forest.

The evergreen forest is the only one of these which is an important source of timber. The Peninsula Mountain forest is a dense evergreen rain forest. One of the commonest trees found is red ironwood, sometimes called in Sierra Leone ironpost, botanically known as *Lophira procera.* Another tree of frequent occurrence is the so-called pearwood (a species of *Mimusops*), sometimes called mahogany when sold as timber; cedar mahogany (*Pseudocedrela* spp.); African walnut (*Lovoa klaineana*); "real" African oak (*Oldfieldia africana*); Rhodesian mahogany, usually called kontah, botanically known as *Afzelia africana;* gum copal tree, known botanically as *Copaifera salikounda,* and oil palm (*Elaeis guineensis*). These have hard woods. There are also many trees with soft wood, scattered among the others, such as whitewood (*Alstonia congensis*) and cotton tree (*Eriodendron anfractuosum*). There are in all about 212 species, of which 15 to 20 are used to some extent locally.

Character of Ownership.—The remaining timber areas are now to be reserved as permanent forest, which would indicate that they are in government ownership or under government control. Thus the Peninsula Mountain forest, comprising about 64,000 acres, the Kagnari Hills, the Kambui Hills, and the Kassewe Hill forests have been set aside as

reserves. Several others have been examined with a view to being reserved.

Annual Growth.—No figures of growth are available for the entire forest area, but it is probably about equal to the cut. Estimates place the amount of standing timber in the Peninsula Mountain forest at 75 million cubic feet, half of which is ready for the axe. It is believed that 750,000 feet could be cut annually from this forest without overtaxing it. Eventually, under forest management, the growth may increase even to 2,500,000 cubic feet per year (100 cubic feet per acre), or nearly twelve times the amount of timber now imported into Sierra Leone.

Annual Cut.—No figures are available as to annual cut. There is practically no cutting of timber for export. A considerable amount is used by the Department of Public Works, but the exact quantity required each year is not available. The natives cut, with a great deal of waste, a fairly large amount of timber for canoes and building. Considerable firewood is being cut also, particularly for Freetown, and a small amount of wood is used for making charcoal. The total cut is probably about 6,800,000 cubic feet, of which only 150,000 feet is saw-timber.

Logging and manufacturing methods are still primitive, so that only a small amount of the available timber is exploited. The total yield is greatly in excess of present local needs.

Annual Consumpton.—Assuming a consumption of 5 cubic feet per capita, the total annual consumption is about 7,000,000 cubic feet. Five per cent of this, or 350,000 cubic feet, is saw-timber.

Exports and Imports.—During the period 1827–1835 an average of about 600,000 cubic feet of timber was exported annually from Freetown. More recently exports have practically ceased, amounting to less than 10,000 cubic feet. On the other hand, some 210,000 cubic feet (2,500,000 superficial feet) is imported annually.

Forest Industries.—The principal forest industry is the palm oil industry—20 to 30 thousand tons of palm kernels and 250 to 600 thousand gallons of oil, worth from $1,000,000 to $2,500,000, are exported annually. There are extensive areas of oil palms in the interior of the colony. Cola nuts bring in about $500,000 per annum and rubber $100,000 to $200,000. Small amounts of gum copal and camwood are also exported.

Forestry Movement.—In 1911 a forest department was formed, the chief work of which so far has been the drafting and passing of a forestry ordinance and the demarcation of forest reserves. The department has closed the gum forests to tappers so that the trees can recover from previous overtapping. The planting of rubber has been undertaken by the department, and several nurseries have been established in different

places for that purpose. Although palm oil is one of the largest articles of export, no planting has yet been undertaken. No revenues have been obtained from the forest reserves, but unquestionably they will eventually yield a monetary return. Considerable botanical exploration has been carried on.

Probable Future.—In spite of the fact that there has been a great deal of forest destruction in the past and that the area per capita is small, Sierra Leone still has forests which, under proper management, can meet the local needs of the population and even provide some of the valuable species for export.

Anglo-Egyptian Sudan and Egypt

Forest Area.—The land area of Anglo-Egyptian Sudan and Egypt is 873,216,000 acres, and the population was estimated in 1917 at 16,150,000. The total forest area is estimated at 7 million acres, or 0.8 per cent of the land area and 0.4 acre per capita. Most of the commercial forests are in upper Sudan, along the courses of the Nile and its tributaries. Egypt is entirely without forests.

Character of the Forests.—Sudan contains no forests similar to the evergreen forests of western and central equatorial Africa. The vegetation is mostly bush; i. e., grass with shrubs and trees scattered more or less thickly over it. The nearest approach to usable timber is in the western Bahr-el-Ghazal region. Acacia thorn trees are plentiful from Khartoum southward to about 10 degrees north latitude.

Along the Nile-Congo watershed, throughout the length of the province of Bahr-el-Ghazal, is an almost unlimited supply of *Khaya senegalensis* (African mahogany) and other timber trees, chiefly the shea butter tree. Balsams and large acacias also occur here. This is the dry ironstone region of the southwest.

The White Nile forests are composed chiefly of sant and other acacias. The Blue Nile forests, north of 12 degrees north latitude, are similar to those of the White Nile, but southward the character of the forest changes and includes Sudan ebony.

The forests are for the most part rather open, with comparatively few trees to the acre which will yield sawlog material. The timber is mostly short, although clear logs 20 feet long by 1 to 2 feet in diameter may be secured. A number of species, such as acacias, palms, and other hardwoods, furnish construction material which is used locally.

The best timber species of the Sudan forests are:

Kakamut (*Acacia campylacantha*).—A heavy wood, very strong and durable.

Sant, or sunt (*Acacia arabica*).—A very hard, durable wood, the dominant species on banks of rivers between Khartoum and 12 degrees north latitude. Used for boat building and fuel.

Inderab (*Cordia abyssinica*).—A light wood, saws easily, suitable for many uses.

Silug (*Anogeissus leiocarpa*).—Abundant in the Blue Nile forests. Wood durable. Grows with ebony and African mahogany (*Khaya senegalensis*) in southern Kordofan and in the higher portions of Bahr-el-Ghazal. African mahogany yields excellent timber.

Heglig (*Balanites aegyptica*).—Grows throughout Sudan. Large sizes, not attacked by ants.

Hashab (*Acacia verek*) and talh (*Talha beida*).—The principal sources of gum arabic. Hashab is also a durable, ant-proof wood.

One of the most important products of the native forests of Sudan at the present time is acacia gum. It is collected in large quantities, especially in the Kordofan district. The Sudan is also rich in trees and plants yielding fibers. The bark and fruit of several acacias are used for tanning. Several shrubs yield rubber or gutta-percha.

Character of Ownership.—Two hundred and thirty-five square miles (150,400 acres) of forest have been set aside as reserves, distributed as follows:

Provinces	*Acres*
Sennar	131,840
Kordofan	16,000
White Nile	2,560
	150,400

In addition there are some 19,520 acres of protected forests. There is a sub-department of forests which has charge of fire protection, the management and protection of the reserved forests, planting, and some forest research.

Annual Cut.—No figures are available regarding the cut of wood in Sudan, but it is not believed to be extensive. The cut is entirely for local use, for framework of native huts, to some extent for railroad ties, and to a considerable extent for native boats, but chiefly for fuel. The average amount of firewood supplied by the Forest Department is 3,500,000 cubic feet a year. The amount of saw-timber cut is comparatively small. A great deal of fuel wood is used by the Nile boats and other public utilities. Very little of this timber reaches Egypt proper. Some, mostly driftwood, is rafted to Khartoum and Omdurman. The total cut is estimated at about 7,888,000 cubic feet.

Exports and Imports.—Egypt is entirely without forests and is obliged to import all the wood used in the country for building purposes and fuel. According to statistics for 1913, the annual import of lumber before the war averaged about 23,000,000 cubic feet and that of fuelwood about 1,412,000 cubic feet, or a total of 24,412,000 cubic feet. The imports were furnished by Russia, Sweden, Rumania, Austria-Hungary,

and the United States. Practically all of the import trade was handled by three firms in Alexandria, although a number of commission houses bought furniture woods on definite orders from customers.

Annual Consumption.—The total consumption amounts to approximately 32,300,000 cubic feet, of which 9,300,000 cubic feet is fuel wood. This is only 2.0 cubic feet per capita, an exceedingly low rate of consumption.

The Probable Future.—An export timber trade from the Sudan forests appears improbable, on account of the difficulties that would be experienced in transport. The fact that the Sudan Government imports large quantities of timber annually for its own works and spends a very small amount for the purchase of native Sudan timber, clearly indicates that the native timber does not figure to a large extent in construction work. The chief obstacles in using Sudan timber are evidently its hardness, weight, and lack of proper milling. The bulk of the imported timber is pine and spruce. In time, however, such timbers as taraiya, homeid, silug, tarfa and heglig will probably be employed to advantage in place of imported pine, and inderab and kakamut will be used instead of imported hardwoods, except in cases where timber of very large dimensions is required.

Nyasaland

Forest Area.—The Nyasaland Protectorate has an area of about 27,909,120 acres and a population of nearly 1,138,000. The forest area may be placed at 280,000 acres, or 1 per cent of the land area. The per capita forest area is thus 0.25 acre.

With the exception of the small stands of Mlanje cypress (*Widdringtonia whytei*), which are confined to the gullies and ravines on the higher slopes and plateaus of the Mlanje mountain at an altitude ranging from 4,000 to 7,000 feet, and the broadleaf trees of fairly large dimensions which are frequently found on the banks of streams throughout the country, the forests of Nyasaland consist chiefly of small hardwoods which rarely attain saw-timber dimensions.

The total area of the small patches of cypress on the Mlanje mountain is about 2,200 acres, of which 700 acres is too inaccessible even for hand sawing.

Important Timber Trees.—The most important trees of Nyasaland are:

1. Mkungusa or Mlanje cypress (*Widdringtonia whytei*), is impervious to termites and very durable. It is extensively used for building purposes.

2. Mbawa or African mahogany (*Khaya senegalensis*), is the chief

wood used by the settlers for building and for furniture. It is inferior to cypress for building, however.

3. Mwenya (*Adina microcephala*) yields a hard, durable wood suitable for heavy beams where great strength and durability are required.

4. Kweranyani (*Piptadenia buchanani*) yields a fine teak-like timber which is used for general building purposes and in bridge construction.

5. Mlombwa (*Pterocarpus angolensis*) is a small tree yielding a very durable wood suitable for bridge-planking, furniture, and various other purposes. It is extensively used by the marine transport department for ship-decking. Once seasoned it does not warp under changeable weather conditions.

Character of Ownership.—The 2,200 acres of cypress forest at Mlanje belongs to the government. Since the proportion of privately owned land in Nyasaland in general is small, it may be safe to assume that the bulk of the remaining forest land is also the property of the crown.

Annual Growth, Cut, and Consumption.—No statistics are available regarding the growth, cut, or consumption. The average annual consumption of sawn cypress is about 13,000 cubic feet, evidently much below the actual growth. The accessible stand of cypress will yield about 1,500,000 cubic feet of sawn wood, or an average of about 1,000 cubic feet of converted timber per acre. While the demand for building material is comparatively small, enormous quantities of firewood are used for tobacco curing, brickmaking, railway locomotives, for the steamships on Lake Nyasa, and for domestic purposes. There is already a scarcity of poles and firewood, and the demand for them is rapidly increasing. Unless planting on an extensive scale is undertaken, Nyasaland will be handicapped in its development by lack of large timber for construction purposes and of firewood for its tobacco and transportation industries. Estimates of cut and consumption are given on pages 41 and 54.

Secondary Products.—No timber is exported from Nyasaland, and the quantity imported yearly is very small. The only forest products exported are rubber and *Strophanthus.*

Of the genus *Strophanthus* the most important species is *S. kombe.* It produces the best seed, small quantities of which are yearly exported to England for medicinal purposes, being chiefly used for the treatment of cardiac affections.

Rubber-yielding plants are represented by several species of *Landolphia,* two of the most important being *L. kirkii* and *L. parvifolia,* both of which are abundant in certain parts of the West Nyasa district and furnish rubber of good quality.

Of the great variety of fiber-yielding plants found in Nyasaland, the

following are known to yield fiber of very good quality: *Sansevieria kirkii, Hibiscus cannabinus, Securidaca longepedunculata* (bauze), *Sida rhombifolia* (nsonongwa), and *Pouzolzia hypoleuca* (lichopwa).

Forest Laws.—Planting has been carried on for fifteen years, 845 acres having been planted up to 1919. Cypress and eucalypts are the chief species used for this purpose. In the forest nurseries, 80,000 to 100,000 eucalypts are raised annually and distributed free of charge to natives for planting.

A forest ordinance, passed in 1911, forbids cutting of African mahogany, or of any timber within 30 yards of a stream or river, without a written permit from the chief forest officer. It also provides for planting of a certain percentage of lands leased for agricultural purposes with trees approved by the chief forest officer, during the first four years of the term of lease, and 5 per cent annually thereafter until 20 per cent of the total area is planted.

Southern Rhodesia

Forest Area.—Southern Rhodesia, which is that part of Rhodesia south of the Zambezi River, has a land area of 97,600,000 acres and a population of 838,000. Of the land area 1,413,760 acres, or 1.4 per cent, is cultivated; 58,560,000 acres, or 60 per cent, is forested, and 37,626,240 acres, or 38.6 per cent, is other land. Of the forested land 11,712,000 acres, or 12 per cent of the total land area, is merchantable forest (of this plantations of exotic trees cover 2,560 acres), and 46,848,000 acres, or 48 per cent of the total, is classed as unprofitable or inaccessible forest. The per capita area of all forests is 70 acres, and that of the merchantable forest is 14 acres.

Character of the Forest.—High or dense forests are comparatively limited in area, and are confined to especially favorable spots in the mountain range which forms the eastern border. They consist of old evergreen trees up to 200 feet in height, with *Khaya nyasica* as the dominant species. This forest occupies only 14,080 acres or 0.02 per cent of the total forest area. On the upper mountain slopes it is characterized by *Cussonia umbellifera,* which reaches 80 feet in height. The dense evergreen forests on the eastern border contain many valuable timbers suitable for building and other purposes, but they are limited in extent and are at some distance from railways. The principal timbers of these forests are:

Brown mahogany (*Lovoa swynnertonii* E. G. Baker). Much used locally for outdoor purposes, the heartwood being very durable and untouched by insects. The tree grows only at Chirinda.

Red mahogany, umbaba (*Khaya nyasica* Stopf). A huge tree, attaining a height of 150 feet or more, and, exceptionally, a diameter of

15 feet. Diameters of 5 to 8 feet are not uncommon. The trunk is almost invariably straight and runs up to a considerable height before branching. The timber is red in color, with a handsome grain, hard but fairly easily worked, and weathers well above ground. It is untouched by *Bostrychidae* or termites.

Swyn, bak, umkuhlu (*Trichilia chirindensis*). One of the largest forest trees, reaching a height of 120 feet or more, with a maximum diameter of about 7½ feet.

Trichilia emetica, Vahl. A smaller tree than *T. chirindensis,* having a wider distribution, and frequently found on the banks of streams. The timber is valuable and is similar to that of *T. chirindensis.*

Mushamba (*Schefflerodendron gazense,* E. G. Baker). One of the largest forest trees at Chirinda, with ochraceous yellow bark and very hard, heavy, whitish timber.

Pygeum africanum, Hook. A large tree, producing valuable red timber suitable for furniture, wagon-building, etc. This is one of the best South African timbers.

Umkadhlwa (*Rauwolfia inebriens* K. Schum). Timber yellowish white and very easily worked. It has been used for house building, being particularly useful for windows and doors. It is claimed that termites and *Bostrychidae* do not attack it. Owing to its rapid and symmetrical growth and the beauty of its foliage, it is being planted by settlers as a shade tree.

Callitris whytei, Rendle. This is by far the best local timber; light, handsome, easily worked, scented, and very durable.

Cussonia umbellifera, Lond. A common tree in the mountain forest, producing greyish-white soft timber, useful for the manufacture of matches, and shooks for the fruit industry.

The prevailing type of forest is savanna, with a park-like general appearance. This forest is subdivided into several types which are not always readily distinguished. It occupies 58,545,920 acres, or 99.98 per cent of the total forest area, and is composed almost entirely of hardwoods. The trees are small in diameter and have short boles. Most of the wood is useful for fuel and mine props. The amount of wood of the kinds used for building European houses is very limited.

The principal timbers of the savanna forests are:

Redwood or Rhodesian teak, "igusi" (*Baikiaea plurijuga,* Harms). One of the valuable trees of the Kalahari sand area. Boles vary in length from 8 to 20 feet and measure 2 to 3 feet in diameter. The timber is red, hard, heavy, and durable, and useful for cabinet work, paneling, etc. It is not attacked by termites or borers, and is therefore useful both above and below ground.

Mahogany, "m'chibi" (*Copaifera colesperma,* Benth). A fairly large tree found in association with *Baikiaea plurijuga.* It attains the same dimensions and has much the same properties and uses as the latter.

Bloodwood, m'vagasi or mukwa (*Pterocarpus erinaceus,* Poir). This tree has a wide distribution, but is usually found at its best on the Kalahari sands, where it frequently occurs in belts. It usually has a straight bole of even taper, up to 25 feet in length. Trees over 12 inches in diameter are not abundant. In youth the sapwood is yellowish white, useful for shook timber and other purposes, while in age a brown heartwood develops. The heartwood is excellent for cabinet purposes. The tree is easily propagated by coppicing.

"Pod mahogany," "m'kamba" (*Afzelia caunzensis,* Welw.). A handsome tree producing valuable timber useful for a variety of purposes, such as furniture, wagons, naves for wagon wheels, etc.

Mopani (*Copaifera mopani,* Kirk.) The timber of this tree is largely used in mines for timbering mainshafts and as props. The heartwood, which is almost black, is very hard and is not attacked by insects.

Diospyrus mespiliformis, Hochst. A tree widely distributed over Southern Rhodesia. The best specimens are usually found on termite mounds or along stream banks. The timber is red, hard, and durable, and is excellent for wagon building, mining work, and general carpentry.

Total Stand.—The total stand of timber is estimated at 11,771,187,200 cubic feet, of which 64 million cubic feet is in the dense evergreen forest.

Character of Ownership.—The state owns 23,424,000 acres, or 40 per cent of all the forests. Corporate bodies own 11,712,000 acres, or 20 per cent, and private individuals 23,424,000 acres, or 40 per cent. The state has no areas especially dedicated to timber production, but some tracts have been withheld from alienation and protected against cutting because of their value for water supply or as possible future state forest reserves.

Annual Growth, Cut, and Timber Trade.—The net annual growth for the 11,712,000 acres of accessible forest has been estimated at 42,681,470 cubic feet, or 3.6 cubic feet per acre. On the 46,848,000 acres of inaccessible forest it is considered that fire injury and natural decay balance the growth. The average annual cut is placed at 61,458,350 cubic feet, distributed as shown in Table 355.

Timber other than firewood thus constitutes 7.8 per cent of the total cut. The average annual export over a period of 7 years, 1913-1919, is given as 34,120 cubic feet. The average annual import over the same period was 258,120 cubic feet, or an excess of import over export of 224,000 cubic feet.

TABLE 355.—AVERAGE ANNUAL CUT, SOUTHERN RHODESIA

Type of product	Quantity
	cu. ft.
Sawn or hand-fashioned timber	41,550
Mine props	4,000,000
Fuel wood—By Europeans	7,656,800
By natives	40,000,000
For mines	9,000,000
Timber for general farm purposes, poles, wattles, kraals, etc.	760,000
Total	61,458,350

Growth and Cut Contrasted.—With an annual cut of 61,458,350 cubic feet and a net increment of 42,681,470 cubic feet, it is evident that the country is overcutting to the extent of 18,776,880 cubc feet per annum.

Domestic Consumption.—With a cut of 61,458,350 cubic feet and an excess of import over export of 224,000 cubic feet, the total home consumption is 61,682,350, or counting only the population living within the zone of accessible forest (438,284), the per capita consumption is 140.7 cubic feet. Of this fuel wood constitutes 56,656,800 cubic feet. For the population as a whole the average consumption is 73.6 cubic feet.

Forest Legislation.—The territory of Southern Rhodesia is administered by the British South Africa Company under royal charter dated 1889. Since mining is the chief industry of the country and timber suitable for mine purposes is abundant, free cutting is permitted. Sixty per cent of the mines obtain their wood supplies without paying any royalty. There are some ordinances prescribing the cutting of trees. Cutting of growing trees under 3 inches in diameter is prohibited; cutting is also prohibited on the banks of all public streams to a distance of 50 feet on either side. In 1913 an ordinance was promulgated, the object of which was to regulate the use of fire so as to prevent destruction of trees and shrubs. Certain species of trees in various districts are also protected. A forest officer has recently been appointed to investigate forest conditions, and his investigations may lead to some forest legislation later on.

Probable Future.—With important mining interests, Southern Rhodesia will require large quantities of mine props and fuelwood. As the country develops and roads and railroads are built, the forests now considered inaccessible will be made accessible. With some fire protection and planting of rapidly growing exotic trees, Southern Rhodesia may be able to supply most of her needs for forest products indefinitely, except ordinary building timber. With a few exceptions, indigenous timbers

are unsuitable, chiefly because of their insufficient length, for ordinary building timber. For this reason, Southern Rhodesia may continue to import coniferous and other structural timber from abroad.

Northern Rhodesia

Northern Rhodesia has an area of about 186,240,000 acres and a native population of about 890,000. The country consists for the most part of high plateau covered with a thin forest. Assuming that the proportion of forests in Northern Rhodesia is the same as in Southern Rhodesia—60 per cent of the land area—then the forests of Northern Rhodesia must be in the neighborhood of 111,744,000 acres, or 125.6 acres per capita.

The forests are similar in character to those of Southern Rhodesia.

Assuming that the per capita consumption in Northern Rhodesia is also about 73.6 cubic feet, the total consumption would be 65,504,000 cubic feet. Of this 92 per cent, or 60,164,000 cubic feet, is firewood, and 8 per cent, or 5,340,000 cubic feet, is saw timber.

Seychelles

This colony is an archipelago composed of a large number of islands located in the Indian Ocean. There is practically no forest left, although the islands were formerly densely wooded. The land area is 99,840 acres and the population 25,000. The forest at most covers 5,000 acres, or 5 per cent of the land area, and 0.2 acre per capita. A few remaining patches of indigenous forest contain several species and genera peculiar to Seychelles. The cosmopolitan takamaka (*Calophyllum inophyllum*), agati (*Adenanthera pavonina*), badamier (*Terminalia catappa*), bois noir (*Alzatea labtek*), and bois de table (*Heritiera littoralis*) are the only trees that are used as sources of timber at present. A few other trees, such as gayao (*Afzelia bijuga*), bois de natte (*Imbricaria seychellarum*), capucin (*Northea seychellans*), bois de fer (*Vateria seychellarum*), and bois maret (*Risleya griffithii*) are practically extinct. Some of them reached large diameters in the original forests. For the last 10 years the government has been reforesting the denuded lands above the Niol reservoir, which is not very far from the reserves of the central ridge of mountains.

Among the timber trees that have been used for reforesting denuded and worn-out pieces of land the following have succeeded:

Bois de table (*Heritiera littoralis*)
Agati (*Adenanthera pavonina*)
Parkia roxburghii
Albizzia moluccana
Tecoma leucoxylon
Casuarina equisetifolia
Gum copal (*Trachylobium verrucosum*)

The consumption of wood is small, probably only 4 cubic feet per capita, or 100,000 cubic feet altogether. Nearly all of it is firewood. This wood is all cut locally, and the growth and cut are about equal.

Swaziland

Forest Area.—The total land area of Swaziland is 4,273,920 acres, and the population about 100,000. The forest area may be placed at 1,088,000 acres, or about 25 per cent of the total area. This constitutes a per capita forest area of 10.9 acres.

Character of Forests.—The forest land of Swaziland may be divided into two zones: the higher veldt and the lower veldt. The higher veldt comprises all the hilly portions of the country lying at an elevation of about 2,500 feet and over. For the most part this zone is grass country, except for small forests or, as they are called in Africa, "bushes" of from 60 to 100 acres in extent, which occur along streams on southeastern exposures. The most accessible of these bushes, or small forests, have all been cut out and used for various purposes, such as wagon building, fencing, and so on. The timber trees that grow in this zone are generally the same kinds of timber as those in the midland forests of Natal and Zululand. In the lower veldt, called the bush veldt, the country is generally of a park-like character, typical of the bush veldt of southeastern Africa. The timber, as a rule, is small, scattered, and crooked. The only merchantable stand of forest still containing a quantity of hardwood is in the neighborhood of the Mbuluzi Poort, called by the natives "Bukunku."

TABLE 356.—PRINCIPAL TREES, SWAZILAND

Botanical name	English name	Dutch name	Use
Sideroxylon inerme	White milk wood	Wit melk houd	Canes and clubs.
Curtisia faginea	Assegai	Assegai	Spokes for wagons. Suitable for turnery and carving work.
Eugenia zeyheri	Jambos	Jambosch	Whipsticks and fishing rods. Firesticks.
Rhamnus zeyheri	Red ivory wood	Rode ivoor	Suitable for inlay and turnery; practically everlasting.
Combretum erythrophyllum.	.....	Rooibosch	Charcoal. Very twisted grain. Light yellow timber like yellowwood but harder.
Combretum kraussii	Bushwillow	.....	Makes excellent yokes, tough.

TABLE 356.—PRINCIPAL TREES, SWAZILAND—*Continued*

Botanical name	English name	Dutch name	Use
Sclerocarya caffra	.....	.....	Wood soft and tough. Makes good wagon felloes.
Syzygium cordatum	.....	Waterboom	Suitable for roofing and other rough carpentry.
Bolusanthus speciosus	.....	.....	Excellent for spokes, handles for tools, and fence posts. Imperishable except in fire. Probably the most useful of Swazi woods.
Rhizophora mucronata	Red mangrove	.....	Valuable timber, resembling teak.
Mimusops obovata	Red milk wood	Rooi melk houd	Wagon wheels.
Acacia pallens	Knob thorn	Knopiesdoorn or Wacht'nbeetje	Resembles walnut, but harder and heavier.
Olea verrucosa	Wild olive	Olyvenhoud	Favorite fence posts of the Cape railways.
Chrysophyllum magalismontana.	.....	Stamfruchte	Excellent timber. It has a fragrance like that of sandal wood.
Brachylaena discolor	Greenheart	Salie	
Cussonia sp	Cabbage palm	Kippersol	Very soft, pithy wood. Valuable in the match trade. Makes excellent roofing timber where preserved from dampness. The only indigenous timber to compete with the soft pines.
Podocarpus elongata	Common yellowwood.	Bastard geelhoud	Used by natives for making battle-axe handles. Has a grain like hickory.
Anona senegalensis	Custard apple	.....	Excellent. Heart wood used by natives for scent.
Excoecaria africana	Custard apple	Tamboti	
Burkea africana	.....	Wilde syringa	Excellent furniture wood; firewood.
Schotia sp	Boer bean	Boerboom	Excellent. Straight growth; extremely pliable, suitable for canoe planking, also wagon beams.

In addition to native timber, there are about 150 acres of planted forests of exotic trees—eucalypts, pines, cypresses, Australian wattles, and oaks. These plantations are largely in the higher veldt. In Table 356 are listed the most useful native timber trees of Swaziland.

There are no sawmills in Swaziland and the small amount of lumber used is worked up by the farmers with hand saws. The consumption of lumber is estimated at 20,000 cubic feet, and of firewood, 380,000 cubic feet, making a total of 400,000 feet, or 4.0 feet per capita. All of this wood is cut locally. Growth probably is about equal to the cut.

Uganda

Forest Area.—The total area of Uganda Protectorate is about 69,836,160 acres, of which 10,481,280 acres is under water. The land area is therefore 59,354,880 acres. The population is 3,361,000. The forest area is not definitely known, but it is estimated to be between 768,000 and 896,000 acres. This makes about 1.5 per cent of the land area and 0.25 acre per inhabitant. There are six important forests:

1. *Minzero forest.* This forest is situated in South Buddu and covers an area of some 32,000 acres.

2. *Mabira forest.* This is one of the best and most accessible forests. It covers 140 square miles—89,600 acres—and is situated in Kyagwe, 17 miles from Jinje Port on Lake Victoria.

3 and 4. *Budongo and Bugoma forests.* These forests are situated in the Bunyoro district near Lake Albert. Their combined area is about 204,800 acres. They are likely to become an important source of timber for Egypt and other regions.

5. *Kabali forest.* This forest is situated in the Western Province, about 10 miles from Toro. It covers an area of 149,200 acres and is almost entirely inaccessible at present, owing to the lack of means of communication.

6. *Malibigambo forest.* This forest lies in Western Ankoli and is about 40 miles from the town of Mbarara. Its area is considerable, but is as yet undetermined.

There are other large unexamined forests on the slopes of Ruwenzori and Elgon mountains, where *Podocarpus* spp., *Faurea saligna,* tree heather (*Erica arborea*), cedar (*Juniperus procera*), and bamboos occur, the latter covering enormous areas.

Some of the principal timber trees are:

Cynometra alexandra (muhindi). Large tree, wood hard, turns and polishes well. Railway ties and other construction purposes.

Chlorophora excelsa (mvuli). Tall tree, wood coarse-grained, suitable for furniture and general building purposes.

Entandrophragma (miovu). Two or three species. Excellent timber. Wood resembles mahogany, turns and polishes well. Furniture and general uses.

Erythrophleum guineense (omuvemu). Fairly abundant; wood suitable for ties if treated.

Khaya anthotheca (munyama).—A very large tree, common in the Bugongo forest. Wood mahogany-like, of light color; an excellent furniture wood.

Maesopsis berchemoides (musisi).—A fairly tall tree, with a uniform round bole, tapering but little. Wood durable, soft, somewhat difficult to work.

Parinarium excelsum (mwasa).—A large tree. A general purpose timber.

Maba sp. (mpimbya).—A medium-sized tree, with fine, clean bole; wood hard, with peculiar dark markings. Hard to saw; planes easily; a generally useful wood.

Alstonia congensis (musoga).—A very large and conspicuous tree, common in the Bugongo forest. Height often exceeds 100 feet. Wood straight-grained, very soft; may be useful for some purposes for which spruce is used.

Podocarpus gracilior (musenene).—A fair sized tree, with a clean, cylindrical bole; wood soft. It works well, and is in demand for all purposes. One of the most valuable woods. It occurs in the Minzero forest, at an elevation of 3,720 feet, and on Ruwenzori at 9,000 feet.

Character of Ownership.—All the forests in the protectorate, with the exception of certain areas in the Buganda Kingdom, are the property of the state. The total area owned by the state is therefore almost 896,000 acres.

Annual Cut, Growth, and Consumption.—All the timber cut is used locally. No timber is exported overseas, on account of the distance of the forests from the coast, and only a limited quantity, chiefly mvuli, is exported to British East Africa. The annual cut, which is estimated at 13,444,000 cubic feet, is much less than the potential growth, but in forests which are now being logged and in which most of the trees are mature, the growth of the species which are being cut may be less than the amount removed. A small amount of coniferous timber is imported from overseas. Comparatively little timber is destroyed annually by fire, except mvuli, which grows in grassland and suffers considerably. There is, however, a fairly large loss through decay, which balances any growth that there may be. About the same amount of wood is consumed as is cut, 95 per cent of it being firewood. This is equivalent to 4.0 cubic feet per capita.

Union of South Africa

Forest Area.—The Union of South Africa has an area of 302,781,440 acres and comprises the provinces of Cape of Good Hope, Natal, Transvaal, and the Orange Free State. The utilization of land may be classified as follows: 13,393,920 acres, or 4.4 per cent, is under agriculture, 1,511,040 acres, or 0.5 per cent, is under forest, and 287,876,480 acres, or 95.1 per cent, is pasturage and waste land. With a population of about 6,000,000 people of all races, the per capita forest area is 0.25 acre. Artificial plantations, chiefly of exotic trees, cover 536,320 acres of the 1,511,040 acres under forest. The trees which are being successfully introduced and now form the mainstay of South African forest extension are *Pinus insignis, P. pinaster, P. canariensis, P. longifolia,* the Mexican pines, black wattle (*Acacia decurrens*), and several species of eucalyptus.

Character of the Forest.—Four main types of forest land are recognized: (1) Forest; (2) scrub; (3) bushveldt; and (4) palm belt.

1. Forests occupy a very small portion of South Africa. Typical forests occur in the Knysna and Humansdorp districts of the Cape, on the southern slopes of the Outeniqua, Longkloof, and Zitzikamma mountains. Smaller areas are found in the west near George, Celedon, and Capetown, and in the east on the Zuurberg, Amatola, Drakensburg, and Lebombo mountains. In the majority of cases these forests are confined to the steep valleys and flanks of mountains facing the ocean. They are composed of tall timber trees and scrub, which are mostly evergreen. With the exception of the yellowwoods, which form by far the greater portion of the stand, the trees may be described as broad-leafed. The principal species are given in Table 357.

TABLE 357.—CHARACTERISTIC TREES OF THE TIMBER FOREST, SOUTH AFRICA

Yellowwoods (conifers)	*Podocarpus thunbergii* (*macrophylla*) Siebold.
	Podocarpus elongata L'Herit.
	Podocarpus falcata R. Br.
Sneezewood	*Pteroxylon utile* E. & Z.
Black stinkwood	*Ocotea bullata* E. Mey.
Black ironwood	*Olea laurifolia* Lam.
Lemonwood	*Xymalos monospora* Baill. (*Xylosma monospora* Harv.?)
White ironwood	*Toddalia lanceolata* Lam.
Candlewood	*Pterocelastrus variabilis* Sond.
Assegai wood	*Curtisia faginea* Ait.
White pearwood	*Apodytes dimidiata* E. Mey.
Saffron	*Elaeodendron croceum*
Wild elder	*Nuxia floribunda* Benth.
Cape box	*Buxus macowani* Oliv. (Only along the coast east of Port Elizabeth and in the Transkeian coastal forests).

2. Scrub is a woodland vegetation typical of the southwest coast region of the Cape, varying in height from one to six feet. The vegetation is typical of dry conditions and the climate is characterized by winter rains and hot, dry summers.

3. Bushveldt is a park-like forest, or savanna, and is made up chiefly of acacias and other deciduous trees. A small portion of it is found in the Southwest Africa Protectorate. The largest area is on the east coast, and is six times the size of that on the west. It includes a large portion of Portuguese East Africa and the northern Transval, and continues beyond the limits of the boundary of the Union into Rhodesia.

4. The palm belt occupies a narrow littoral strip extending from near East London to beyond the northern limits of the boundary of the Union. It is characterized by palms. The northern portion of this belt is more tropical in character and comprises dense swamp forests of mangroves. Among the palms are: *Phoenix reclinata* Jacq. and *Raphia vinifera* P. Beau. Coconut palm, *Cocos nucifera* L., is often a dominant feature in the landscape.

Character of Ownership.—Only 37.27 per cent of the total productive forest area, or 563,200 acreas, belongs to the state; 22,400 acres, or 1.48 per cent, to corporate bodies, and 925,440, or 61.25 per cent, to private individuals.

Annual Growth.—The annual growth is estimated at 150 cubic feet per acre for plantations, 31 cubic feet for natural forests under state control, and 20 cubic feet per acre for natural forests under other ownership. The total growth is estimated at 105,320,960 cubic feet (Table 358).

TABLE 358.—ANNUAL GROWTH, UNION OF SOUTH AFRICA

Type of forest	Area	Estimated increment per acre	Total gross increment
Under State control:	*acres*	*cu. ft.*	*cu. ft.*
Plantations	74,240	150.0	11,136,000
Indigenous forests	488,960	31.0	15,157,760
Other:			
Plantations	462,080	150.0	69,312,000
Indigenous forests	485,760	20.0	9,715,200
Total	1,511,040	69.7	105,320,960

The average growth for the entire area is thus 69.7 cubic feet.

The loss from fire is insignificant, amounting to not more than 1 per cent of the total gross increment, or 1,053,210 cubic feet.

Annual Cut.—The annual cut is given in Table 359.

TABLE 359.—ANNUAL CUT, UNION OF SOUTH AFRICA

Type of forest	Type of product	Quantity
		cu. ft.
Under State control:		
From plantations	Fuel	1,561,764
	Wagon-wood, saw-wood and fence poles	661,858
From indigenous forests	Fuel	1,806,145
	Wagon-wood, saw-wood, and fence poles	960,898
Total		4,990,665
Other:		
From plantations	Fuel	6,764,876
	Fuel from black wattle areas	33,205,500
	Mine props, wagon-wood, saw-wood, and poles.	6,063,400
From indigenous forests	Fuel	2,800,335
	Mine props, wagon-wood, saw-wood, and fence poles.	12,117,100
Total		60,951,211
Grand total		65,941,876

Cut and Growth Contrasted.—The present cut is below the annual growth. The fact that the imports far exceed the exports would indicate that the largest growth is now in the plantations, which are still young and do not furnish exploitable material. Meanwhile the drain is centered on the more exploitable natural forests. Within the next ten or fifteen years these forests will be more or less worked over and the virgin timber removed. After that the yield from the indigenous forest will probably drop very considerably, probably to half of the present output. On the other hand, the plantations of exotic species will mature and the output from them will steadily increase. In the meantime, as the country is opened up, some of the forests now remote may become accessible and thus enable the present output to be maintained for a longer period.

Exports and Imports.—Exports amount to 43,000 cubic feet, while imports are 19,500,000 cubic feet, thus exceeding the exports by 19,457,000 cubic feet. The exports consist largely of unmanufactured boxwood, stinkwood, and yellowwood, which are shipped to the United Kingdom, France, Germany, and Holland. The imports, on the other hand, consist chiefly of pine, hickory, oak, walnut, yellow poplar, and a large amount of flooring and ceiling. It is of interest to note that out of a total of

9,559,316 cubic feet of pine imported in 1913, Sweden supplied 4,542,563, the United States of America 2,086,555, Norway 1,918,774, Canada 644,000, and Russia 343,140, while the balance is made up of small parcels from various other countries.

Out of a total of 98,628 cubic feet of teak, India furnished 92,934, the Dutch East Indies 4,010, and Siam 1,263.

The Australian Commonwealth furnished 24,678 cubic feet of Australian hickory, and the United States of America 15,873 cubic feet of true hickory.

The whole of the 242,181 cubic feet of jarrah and karri came from Australia.

The United States of America furnished 4,383 cubic feet of mahogany, British Honduras 2,039, Nyasaland 984, British West Africa 694, and Portuguese West Africa 647, while various small amounts were received from other countries.

The United States of America supplied 124,758 cubic feet of oak, Japan 16,998, the United Kingdom 2,966, China 2,415, Austria-Hungary 1,987, Austria 1,526, and Canada 470.

Of the poplar imports, the bulk, 92,969 cubic feet, came from the United States of America. This is probably yellow poplar, or tulip tree (*Liriodendron tulipifera*). The United Kingdom furnished 3,951 cubic feet, presumably true poplar (*Populus*).

Out of the total of 67,674 cubic feet of walnut, 66,804 came from the United States of America.

Of unmanufactured timber, Russia furnished 474,452 cubic feet, Canada 240,869, Australia 170,917, the United States of America 96,710, Sweden 61,282, Norway 30,492, China 8,257, the United Kingdom 6,041, and Germany 4,268, while small parcels came from other countries.

Of flooring and ceiling, Sweden and Norway supplied the greater portion, namely, 2,830,614 and 1,026,397 cubic feet, respectively. Russia contributed 39,421, the United States of America 29,447, and Canada 28,473 cubic feet.

Of other planed and grooved wood, Canada furnished 117,363 cubic feet, the United States of America 114,677, Sweden 39,697, Russia 5,365, Norway 1,969, Australia 1,190, and Germany 1,127.

Domestic Consumption.—With an annual cut of 65,941,876 cubic feet, exports 43,000 and imports 19,500,000, the home consumption is 85,398,876 cubic feet, or 14.2 cubic feet per head of population. Of this, fuel forms 46,138,620 cubic feet, or 54 per cent.

Wood-Using Industries.—There are a large number of wood-using industries in the Union. These employ 9,654 persons and turn out articles valued at $13,573,110. The largest industry is sawmilling, the value of whose annual output is $3,730,162. It is closely followed by

furniture manufacture. Next in importance come the vehicle industry, carpentry and joinery, cooperage, and box manufacture. Of the $7,370,-525 worth of raw materials used by these industries, only $2,092,604 worth, or 28.4 per cent, is South African material, the rest being imported.

Forestry and Forest Laws.—In 1913 the forest laws previously in force in the four provinces of the Union were consolidated. Under this law, amended in 1917, the Forestry Department, which is a sub-department under the Minister of Agriculture, has the authority to purchase and expropriate land for certain forest purposes. It deals specifically with the protection of private forests, and makes regulations as to the cutting of timber and grazing and pasturing of animals in the forest, as well as hunting and fishing.

The danger of fires in the native forests of the Union is slight because of the prevalent moisture. But precaution is necessary in the planted areas, and fire lines are maintained around them, inflammable material being burned off outside these lines.

The Forestry Department carries on afforestation of waste lands with exotic species, including commercial softwoods and eucalypts. Over 12,000 acres were planted during 1919 and 1920 and plans were made to plant about 9,500 acres in 1921. Much wood is wasted annually on account of shortage of supervisory personnel and the consequent impossibility of controlling the depredations of the natives.

Control and reclamation of drift sand on the coast is another activity of the Department, 5,170 acres of drift sand having been permanently reclaimed at Port Elizabeth in 26 years.

The Forestry Department may also prohibit the exportation of any kind of forest products. It is charged with the control of plantations owned and financed by the Administration of Railways and Harbors. These plantations are termed "railway sleeper plantations." In 1919 the area actually afforested on behalf of the railway administration was 23,525 acres.

The government authorities aid private owners in afforesting their land by distributing forest trees and seeds at very low prices. Thus in 1919 over 5 million transplants were sold from the government nurseries. Most of these trees were planted in Transvaal and Orange Free State. The mining companies are especially active in establishing plantations to supply timber for their own use. The department gives advice free of charge as to the selection of species, methods of cultivation, valuation of existing plantations, and the like. In order to aid farmers to undertake planting operations, the government land bank of the Union advances money on mortgage at 5 per cent, repayable in 30 years. Planting by

private societies is encouraged by annual grants in the form of prizes for the best plantation.

Land under forest or plantation is taxed at the same rate as land without trees; the forest or plantation bears no burden beyond the ordinary land tax.

While the revenues of the Forestry Department are now only about half as large as the expenditures, they are increasing steadily.

Forest Education.—No forest school for the training of officers of the higher grade is in existence in South Africa. Such officers are recruited, as far as possible, from South African students who have obtained degrees from recognized European or American forest schools. A forest school for the training of a subordinate staff exists at Tokai, Cape Peninsula. The course of training occupies a period of approximately one year and nine months, of which one year is spent at a forest station and nine months at the school.

Secondary Forest Products.—*Wattle Bark.* The black wattle bark industry is of large proportions, especially in Natal. The bark is obtained from *Acacia decurrens* var. *mollis,* a tree introduced from Australia about fifty years ago. Today approximately 312,000 acres is under black wattle in the Union, of which approximately 240,000 acres is in Natal. Besides being used locally as a tanning agent large quantities are exported. It is exported either chopped up and compressed in bales, ground, or as an extract. The exports for the four years, 1916-1919, were as follows:

		Tons	*Tons*
1916	Bark	51,402	51,841
	Extract	439	
1917	Bark	41,753	42,996
	Extract	1,243	
1918	Bark	48,172	51,895
	Extract	3,723	
1919	Bark	56,538	62,681
	Extract	6,143	

Buchu. This is a medicinal product made of dried leaves of two or three species of *Barosma,* shrubs which grow on the mountains in several of the southwestern districts of the Cape Province. The most valuable kind is *B. betulina,* which grows principally on the Cedarberg Mountains, but also in the Tulbagh, Ceres, and Piquetberg divisions of the Cape. There is a considerable demand for this product in Europe and

America and large quantities are exported annually. The exports for the four years, 1916-1919, were as follows:

	Tons
1916.....	58
1917.....	55
1918.....	40
1919.....	67

Probable Future.—The natural forests of the country are not sufficient to meet its needs. Although the native forests produce timbers which for special purposes are unsurpassed in the world and for which there will always be a strong demand as, for instance, stinkwood for furniture, these forests, even under proper management, can never be expected to supply more than a fraction of the country's requirements. The native forests are mostly hardwoods, and the woods the country uses most largely are softwoods, which must be planted. Experience has shown that such softwoods can be grown successfully in certain localities, and it is only by extending these plantations that the Union can hope to become to any extent independent of other countries for its needs.

Important Trees.—The most important native timber trees are the following:

Assegai (*Curtisia faginea*).—A tree 1 to 1½ feet in diameter, 40 to 60 feet high. Wood heavy, hard, and moderately strong. Used for poles, but chiefly as a wagon wood, especially for spokes. Supply limited.

Black ironwood (*Olea laurifolia*).—A large tree 2 to 4 feet in diameter, 60 to 90 feet high. Wood very hard and heavy, very strong. Used for wagon work generally, piles, bridges, telegraph poles, and railroad ties. Supply rather limited.

Cape box (*Buxus macowanii*).—A small tree, 6 to 12 inches in diameter, and from 10 to 20 feet high. Supplies have for some time been exported to Britain and used in place of European boxwood (*B. sempervirens*) for inlaying in cabinet making, and the manufacture of rules, measures, etc., including slide rules. Fairly large supplies are available for export.

Kamassi or Knysna box (*Gonioma kamassi*).—A small tree usually less than 12 inches in diameter and about 20 feet high. Used for weaving-shuttles. Its wood is very similar to that of *Buxus macowanii.*

Sneezewood (*Ptæroxylon utile*).—A small tree up to 2 feet in diameter and 50 feet high. Wood heavy and hard, exceedingly strong, tough, permeated with an oily substance which makes it extremely durable in the ground and white ant resistant; easily split. In great demand for fence posts, piles, and bridges. Is known to resist the teredo when used for marine works. Supply very limited.

Stinkwood or Cape laurel (*Ocotea bullata*).—A large evergreen tree of the first economic importance, 3 to 5 feet in diameter, 60 to 90 feet high. Wood heavy, hard, and strong. Used for furniture, planks, beams, and wagon wood (except spokes). Only limited supplies available.

White pear (*Apodytes dimidiata*).—A tree 1 to 3 feet in diameter, 40 to 70 feet high. Wood hard and strong; preferred by wagon makers to any other wood for felloes.

Yellowwood (*Podocarpus* spp.).—There are three species of yellowwood indigenous to the Union, namely, *Podocarpus elongata,* the common, bastard or Outeniqua yellowwood; *P. thunbergii,* the real or upright yellowwood; and *P. falcata,* the falcate yellowwood.

All are large trees of the first economic importance, 80 to 120 feet high, with little taper, and usually 2 to 4 feet in diameter at breast height. Wood light, moderately strong, non-resinous, and a superior substitute for imported pine timber or spruce. Harder and heavier than pine, but much stronger and greatly superior in appearance. Requires great care in seasoning. Excellent for beams, rafters, flooring and ceiling, doors, butter boxes, planks, furniture, and ties when creosoted. Most abundant species in the forests, but has been heavily exploited.

Zanzibar

The forest which formerly extended over the island of Zanzibar has now largely disappeared. The eastern half is covered with low shrub, and while the vegetation of the western half is luxuriant there are few timber trees. Mangroves are present in the swampy districts.

The total forest area is estimated to be 9,000 acres, or 2.2 per cent of the land area (409,600 acres). With a population of some 113,600, this constitutes a per capita forest area of 0.08 acre.

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FRENCH POSSESSIONS IN AFRICA

French African possessions include Tunisia, Algeria, Morocco, Senegal, Guinea, Ivory Coast, Dahomey, French Congo, Madagascar, Somaliland, and the great interior region of the Sahara. The total area is about 2,053,151,560 acres and the population 31 million.

More than 150 million acres is occupied by forest, with a stand of nearly 350 billion cubic feet, of which over 110 billion is saw-timber.

The northern strip of colonies along the Mediterranean coast is rather poor in timber, while the interior Sahara region has none. The colonies on the west coast, from Senegal southward, fall within the great Guinea Coast tropical forest belt.

In Table 360 there is presented a statistical summary of the forest situation in the French African colonies, not including those under German control prior to 1914.

Algeria

Forest Area.—The land area of Algeria is 142,195,200 acres (222,180 square miles), and the population 5,564,000. The total area of forests is estimated at about 7,500,000 acres, or 5 per cent of the land area and 1.3 acres per inhabitant.

On a large part, possibly two-thirds, of this area, stands are understocked as a result of fires, grazing, and excessive cutting, and the productive capacity is generally limited to fuel wood.

Character of the Forest.—The only species which form continuous forests of any size are cork oak (*Quercus suber*), zeen or Algerian oak (*Quercus mirbeckii*), "afares" oak (*Quercus afares*), holm oak (*Quercus ilex*), Aleppo pine (*Pinus halepensis*), maritime pine (*Pinus maritima*), cedar (*Cedrus atlantica*), thuya (*Callitris quadrivalvis*), and juniper

TABLE 360.—FOREST SITUATION IN FRENCH AFRICA

Colony	Total land area	Population	Forest area			Exports	Imports	Difference[1]
			Total	Ratio to land area	Per capita			
	acres		*acres*	*per cent*	*acres*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*
Algeria	142,195,200	5,564,000	7,500,000	5.0	1.30	603	13,102	−12,499
Dahomey	26,429,000	900,000	2,770,000	10.5	3.10	.....	14	− 14
French Congo	192,000,000	8,000,000	80,000,000	41.7	10.00	4,497	.....	+ 4,497
Guinea	59,520,000	1,812,000	3,200,000	5.0	1.80	70	70	.....
Ivory Coast	80,000,000	1,562,000	30,000,000	37.5	19.20	1,616	28	+ 1,588
Madagascar	145,920,000	3,545,000	23,500,000	16.1	6.60	303	.....	+ 303
Mauretania	220,778,880	256,000	.....	.....	.....	.....	.....	.....
Morocco	142,614,400	5,400,000	3,700,000	2.6	0.70	.....	1,624	− 1,624
Sahara Territories	960,000,000	.....	.....	.....	.....	.....	.....	.....
Senegal	47,367,680	1,444,600	950,000	2.0	0.70	.....	440	− 440
Somaliland	3,705,600	206,000	.....	.....	.....	.....	.....	.....
Reunion	620,800	178,000	7,410	1.2	0.04	.....	.....	.....
Tunisia	32,000,000	1,940,000	3,000,000	9.4	1.50	790	2,500	− 1,710
Total	2,053,151,560	30,807,600	154,627,410	7.5	5.00	7,879	17,778	− 9,899

[1] +Indicates exports exceed imports; −indicates imports exceed exports.

(*Juniperus phoenicea*). The forests are similar to those of Spain, Italy, and extreme southern France in that they contain a large number of evergreen species. Cork oak and Aleppo and maritime pines are the most important trees of Algeria.

The character of the forest may be well judged by the composition of the state forests. Thus, of the 4,322,500 acres of state forests in the civil territory, cork oak occupies 592,800 acres, or 13.7 per cent; zeen oak, 98,800 to 123,500 acres, or 2.3 to 2.9 per cent; kermes and holm oak, 988,000 to 1,235,000 acres, or 22.9 to 28.6 per cent; Aleppo pine, 1,482,000 to 1,729,000 acres, or 34.3 to 40.0 per cent; cedar, 61,750 acres, or 1.4 per cent; juniper and thuya, 247,000 to 370,500 acres, or 5.7 to 8.6 per cent; and miscellaneous species, such as poplar, elm, ash, olive, maritime pine, etc., 37,050 to 49,400 acres, or 0.9 to 1.1 per cent. In other words, about 50 per cent is composed of conifers and the other 50 per cent of hardwoods, chiefly oak.

The forests of cork oak in Algeria occupy an area of about 1,052,220 acres. They are much denser and more extended in the east than in the west.

Character of Ownership.—The state owns nearly 5,592,000 acres, or 74.6 per cent, of the total forest land. The state forests are distributed as follows:

	Acres
Department of Algiers.....	1,199,500
Department of Oran.....	1,878,700
Department of Constantine..	2,513,800
Total.....	5,592,000

Annual Cut and Growth.—The average annual cut of sawlog material and firewood in the state forests of Algeria for the six-year period 1909-14, inclusive, amounted to 4,441,000 cubic feet, or 94,357 tons by weight. Of this, 2,891,200 cubic feet was firewood, equivalent to about 10,000 tons of charcoal, 819,900 cubic feet was sawlog material, and the remainder consisted of cross-ties, posts, and poles. The cut from private forests is more difficult to ascertain, but it is estimated at 10,590,000 cubic feet, or 450,000 steres, mostly in the form of firewood. The average cut per acre in state forests is thus 0.8 cubic foot, and the cut of sawlog timber is 0.15 cubic foot. The cut per acre for all forests is 2.0 cubic feet. The growth is approximately equal to the cut, or 15,031,000 cubic feet.

Exports and Imports.—The average annual import of construction timber for the period from 1901 to 1913, inclusive, was 5,602,600 cubic feet (79,354 metric tons). The average annual export of construction timber for the same period was 187,020 cubic feet (2,649 tons), or an excess of imports over exports amounting to 5,415,580 cubic feet (76,708

tons), valued at $1,566,581. The average annual import of all kinds of unmanufactured wood, including fuel wood, from 1901 to 1913, amounted to 6,635,170 cubic feet (94,139 tons), and the export to 506,390 cubic feet (7,858 tons), or an excess import of 6,128,780 cubic feet. Of this, 2,274,030 cubic feet came from France and 4,361,140 cubic feet from other countries. The average import of manufactured wood products for 1901 to 1913 amounted to 6,466,400 cubic feet (67,846 tons) and the export to 96,640 cubic feet (1,014 tons). The average import of firewood, on the other hand, amounted to only 44,170 cubic feet (782 tons), while the export was 193,560 (3,427 tons).

Of the imports, walnut, oak, and beech came for the most part from France, with the exception of small amounts from Hungary and the Balkan states, but the building material (mostly soft or coniferous woods) came from Russia, the Scandinavian countries (especially Sweden), Austria-Hungary, and North America. The exports of cork oak are of especial importance.

Domestic Consumption.—With an annual cut of 15,031,000 cubic feet and an excess import of common timber of 6,128,780 cubic feet, the total consumption of wood in unmanufactured form is 21,159,780 cubic feet, of which 13,331,810 cubic feet is firewood and 7,827,970 cubic feet construction timber. The total per capita consumption is thus 3.8 feet, of which firewood is 2.4 cubic feet and building material 1.4 cubic feet. This does not include the amount of wood imported in the form of furniture, etc. The excess of imports over exports of manufactured wood products is 66,832 tons, or 6,369,760 cubic feet. Including this, the annual consumption becomes 27,529,540 cubic feet, or 4.9 feet per capita. Algeria is producing all the fuelwood it needs, but depends on importation for from 80 to 85 per cent of the timber necessary for construction and other industrial uses.

Forestry Movement.—There is a forest department in Algeria, which is a part of the forest administration of France. This department is charged with the administration of state, communal, and public forest reserves, private forests in which the state, communes, and public institutions have joint proprietary rights, and areas whose reforestation has been declared to be of public benefit.

Revenue from State Forests.—In 1910 the gross revenue from the 4,829,885 acres of federal forests in the civil territory managed by the Forest Service was $740,252, more than $579,000 of which came from cork oak operations. In addition, material worth $218,327 was given away during the year. This makes an average yield per acre of 20 cents. The cost of forest administration was 14 cents per acre for the year 1903; approximately the same rate of expenditure is still maintained.

The Cork Industry.—The harvest of cork in the state forests alone amounted to 25,395,228 pounds in 1910, 23,423,875 pounds in 1911, and 28,029,946 pounds in 1912. The state and some of the private operators sell their cork raw, that is, in the condition in which it is taken from the tree, except that it is allowed to dry for 40 days, during which it loses from 20 to 22 per cent of its water. The cork is then prepared and delivered to the consumers and is submitted successively to various operations. The grading is based on the thickness and the quality of the cork. Differences in thickness permit a division of the cork into four categories, each of which is further sub-divided into three or four qualities, according to the fineness of the product. The categories are as follows:

1. Cork measuring 1.21 inches, and more, in thickness.
2. Cork having a thickness of 1.01 to 1.20 inches.
3. Cork having a thickness of 0.91 to 1.00 inch.
4. Cork having a thickness of 0.90 inch and less.

The cork gathered in the forests of Algeria, whether private or public, is nearly all exported, either in the crude state, as it is taken from the tree, in slabs; after having undergone a certain process of preparation, usually of boiling in water for an hour, scraping, or removal of the hard crust, and sorting; or in manufactured merchandise such as stoppers. The amount of crude and semi-manufactured cork exported in 1909 was 24,922 tons; in 1910, 31,037 tons; 1911, 31,825 tons; 1912, 35,775 tons; 1913, 41,914 tons; 1914, 31,606 tons; 1915, 12,191 tons. About 90 per cent of the crude cork was collected from state forests. The chief consumers of cork, outside of France, are England, Russia, Germany, southeastern Europe, and the United States. Algeria, together with Tunisia, furnishes more than one-fourth of the world output of cork.

The Probable Future.—The Algerian forests will continue to furnish large quantities of cork for export and ample firewood for local use. For the bulk of its construction timber, however, the country will continue to depend upon imports.

Dahomey

Forest Area.—The land area of Dahomey is 26,429,000 acres and the population 900,000. The forest area is estimated at 2,770,000 acres, or 10.5 per cent of the land area and 3.1 acres per inhabitant.

Character of the Forest.—After the first mile or two of sandy waste the 50-mile-wide coastal plain is for the most part covered with dense tropical forest. Beyond that, except for the forests along the rivers, the interior is an undulating plain with only occasional patches of forest, which contain baobab and coconut and oil palms.

Exports and Imports.—The exports, which are principally palm oil and kernels, in 1913 amounted to 7½ tons, valued at $264. About 14,000 cubic feet of pine and fir construction lumber, valued at $17,000, was imported in the same year.

Cut, Growth, and Consumption.—The annual cut has been estimated at 4,486,000 cubic feet, of which 98.4 per cent is firewood. The growth is probably equal to the cut. The total consumption is estimated at 4,500,000 cubic feet, or 5.0 cubic feet per capita.

French Congo

Forest Area.—The French Congo, or Gaboon, is the most favored of the French African colonies from the standpoint of forest resources. Not only do the forests contain a vast number of excellent commercial timbers, but they are located near enough to the coast to be easily accessible by water. The land area of French Congo proper, exclusive of Middle Congo, is upward of 192,000,000 acres. The forest area is estimated to cover possibly 80,000,000 acres, or about 41.6 per cent of the area, and 10 acres per capita.

Character of the Forest.—The usual mangrove belt occurs along the coast and up the rivers, adjoining a belt of dense equatorial hardwoods. Farther in from the coast the forest is interrupted by frequent savannas, and gradually thins out into the plains region of grasses and scrub. The great equatorial forest extends along the coast from the border of the former German Cameroon on the north to that of the Belgian Congo on the south, for a length of 420 miles and an average width of 120 miles. The area covered by dense forests is not less than 35,500,000 acres, one-third of which is virgin forest and two-thirds second growth. The stand has been estimated at from 700 to 1,000 cubic feet per acre of saw-timber suitable for export. The virgin forest contains over 300 species of trees, and is fairly uniform on all slopes and soils. Among the species are 8 of the mahogany group, 30 good cabinet woods, 30 good for interior finish, and a number suitable for construction. There are a number of dyewoods, such as indigo and camwood, but these are not so important as they were before the development of coal-tar dyes. Several species of the Congo are now fairly well known. These are:

Okoumé, or Gaboon mahogany (*Aucoumea klaineana*). A very light mahogany. Wood hard and resistant. Suitable for furniture, veneer, flooring, and carpentry. Resembles mahogany and is used chiefly for interior finish. It also serves as veneer or for plywood. White or red okoumé has been used in the carriage or automobile industry. It has been used in great quantities by German manufacturers for making cigar boxes, and tobacco manufacturers of France are beginning to use it.

French colonial foresters claim that okoumé will eventually take the place of southern yellow pine and fir in French markets. Seats in the street cars of Paris are now made for the most part of this wood, and railway companies are using it for many purposes for which soft broadleaf species were formerly used.

Mahogany. The African mahoganies are derived from several species of the genera *Khaya* and *Entandrophragma*. Another wood known on the market also as a mahogany is *Sarcocephalus diderrichi* of the *Rubiaceae* family. The mahoganies of the French Congo are comparable to the woods imported under this name from Central America, the Antilles, and western French Africa. They serve practically the same purposes as true mahogany.

African walnut. This wood is derived from several species of different genera—*Lovoa klaineana* and other species, such as *Dominguila*. It is used for automobiles, railway coaches, and furniture.

Manioca and moabi (*Baillonella toxisperma*, of the *Sapotaceae* family). Wood rose-colored, fine-grained, handsome texture. Stronger than oak. Suitable for heavy building, fine flooring, cabinet work, and all uses requiring strength and fine appearance. These woods are used especially as a substitute for oak. The important French railway companies and shipbuilding corporations have placed large orders for manioca.

Padouk, or coral wood (*Pterocarpus angolensis*). Suitable for cabinet work, interior decoration, flooring, and framework. Does not decay in water. Congo padouk is of the same color as padouk of the British Indies, although it grows dark through usage while that from the Indies preserves its salmon color. The color of African padouk is a rather bright red.

African oak (*Oldfieldia africana*, of the *Euphorbiaceae* family). This species resembles oak in its grain and in its lemon color, which make it desirable for furniture and for interior finish. A substitute for oak or teak. It has given excellent results as a shipbuilding timber. Its hardness and strength are between those of oak and teak.

African acacia (*Sapotaceae*). Congo acacia has the same qualities as locust (*Robinia*), but is of larger dimensions. African acacia is used especially for carriage building, and is suitable also for spokes. It has been used as a substitute for oak, ash, and hornbeam. It is one of the most promising African woods.

Dileba. Botanical identity undetermined. Resembles teak, and works well. Sheathing timbers, railway coaches, heavy carpentry, etc.

Bubinga (*Brachystegia* sp.). Bubinga is much like rosewood. Logs of large dimensions can be used as a substitute for rosewood.

Vuku. Botanical identity undetermined. This wood is fine-grained,

and is suitable for making casting patterns and for certain parts of cabinet work. It can be used as a substitute for sycamore and yellow poplar.

Besides the woods just described, which are most commonly used in Europe, there are a large number of species which will probably be introduced into use in Europe. According to Auguste Chevalier, the forests of the French Congo contain not merely hard or cabinet woods. Of the 211 species which he enumerates, 24 per cent are soft woods, 17 per cent are moderately hard, and 59 per cent are very hard and heavy. The following are a few of the more important species which may have commercial importance in the future:

Asas (*Bridelia* sp.?). The wood is moderately hard. Its specific gravity when dry is from 0.5 to 0.7, and its weight is about 31 pounds per cubic foot. It does not warp. Its chief use is for interior carpentry and construction. The tree is comparatively small, rarely exceeding 20 inches in diameter and 65 feet in height. Not very abundant.

Bahia (*Mitragyna macrophylla*). Wood comparatively soft. Specific gravity from 0.6 to 0.7 and weight about 42 pounds per cubic foot. Suitable for light carpentry work and construction. Capable of replacing satinwood of America. The tree attains diameters of 35 to 40 inches and a height of about 65 feet.

Bilinga (*Sarcocephalus trillesii*). Wood hard, weighing about 50 pounds per cubic foot. It does not warp. A beautiful wood, suitable for cabinet work. Can be used also in carpentry. A large tree, attaining a diameter of 40 inches and heights of 90 to 100 feet.

Canarium (*Canarium velutinum*). Wood soft, weighing from 20 to 25 pounds per cubic foot. Suitable for light carpentry work and construction. The tree attains a diameter of about 40 inches and heights of 65 to 70 feet.

Douka (*Dumoria africana*). Wood moderately hard, weighing from 43 to 45 pounds per cubic foot. Its principal uses are for cabinet work, interior carpentry, and construction. A beautiful tree, attaining 5 feet in diameter and about 95 feet in height.

Iroko (*Chlorophora* regia and *C. excelsa*). Moderately hard, weighing from 37 to 43 pounds per cubic foot. Suitable for the same uses as oak, for which it is considered a substitute. A fine tree, straight and cylindrical, attaining a diameter of over 5 feet and a height of about 100 feet.

M'bebame (*Chrysophyllum* sp.?). A relatively soft wood, weighing from 37 to 43 pounds per cubic foot. Suitable for carpentry and construction, and for other purposes for which oak is used. The tree attains a diameter of about 40 inches and heights of 65 to 80 feet.

Movingui (*Distemonanthus benthamianus*). Moderately hard, weighing from 37 to 48 pounds per cubic foot when dry. A beautiful

wood, suitable for cabinet work, carpentry, and construction. Claimed to be a good substitute for yellow poplar of North America. The tree attains a diameter of about 32 inches and heights of 65 to 80 feet.

Olonvogo (*Fagara* sp.). Wood moderately hard, weighing when dry from 32 to 42 pounds per cubic foot. Considered a substitute for oak of the temperate regions. The tree is of average dimensions, attaining about 3 feet in diameter and about 75 feet in height.

Onzabili (*Antrocaryon klaineanum*). Wood soft, weighing from 32 to 43 pounds per cubic foot. Suitable for carpentry and construction. A handsome tree, attaining a diameter of 5 feet and heights of 80 to 100 feet.

Ossongo (*Anthostema aubryanum*). Wood relatively soft, weighing from 25 to 30 pounds per cubic foot. Suitable for light carpentry and construction. A tree of average dimensions, attaining a diameter of 3 feet and a height of 65 feet.

Rikio (*Uapaca guineensis*). Wood moderately hard, weighing from 43 to 50 pounds per cubic foot. Suitable for interior carpentry, construction, and also for the manufacture of staves. The tree attains a diameter of 3 feet and a height of 50 feet.

Tsoumbou (*Piptadenia* sp.). Wood moderately hard, weighing from 32 to 43 pounds per cubic foot. Suitable for carpentry and construction. A tree of average dimensions, attaining a diameter of 3 feet and heights of from 65 to 80 feet.

Niove (*Staudtia gabonensis*). Wood hard and heavy, weighing from 50 to 63 pounds per cubic foot. Suitable for carpentry and construction; also probably for railroad ties. A tree of average size, having diameters of 32 to 36 inches and heights of 65 to 80 feet.

Okip (*Klainedoxa gabonensis*). Very hard and heavy wood, weighing from 62 to 65 pounds per cubic foot. Wood too heavy for general carpentry work but can be used for construction and also for railroad ties. The tree attains a diameter of 4 feet and heights of 80 to 100 feet.

African poplar (*Spathodea campanulata*). Very soft and light wood, weighing from 20 to 25 pounds per cubic foot. Suitable for light carpentry work and for the manufacture of pulp.

Azobé (*Lophira procera*). Wood very hard and heavy, weighing when dry from 63 to 85 pounds per cubic foot. Too heavy for general use, but suitable for heavy carpentry work, piling, and railroad ties. A beautiful tree, attaining diameters of 4 to 4½ feet and heights of 80 to 100 feet.

Mangrove (*Rhizophora racemosa*). Wood very hard, weighing when dry 63 to 65 pounds per cubic foot. Too heavy for average carpentry use, but suitable for railroad ties and possibly staves.

Alep (*Irvingia oblonga*). Wood very durable and heavy, weighing

when dry from 63 to 70 pounds per cubic foot. Too heavy and hard for ordinary use, but suitable for very heavy carpentry, piling, and railroad ties. A fine tree, attaining a diameter of nearly 4 feet and a height of 80 feet.

There are woods in the French Congo similar to most of those used in France as building timber. Soft and semi-hard woods used in carpentry are even more abundant in the French Congo than hard woods.

Cut, Growth, and Consumption.—The annual cut has been estimated at 44,497,000 cubic feet, of which 90 per cent is firewood. The potential growth is enormous, but since the forest is almost entirely virgin the actual growth is probably only equal to the cut. At an average export of about 4,500,000 cubic feet, the total consumption is in the neighborhood of 40,000,000 cubic feet, or 5 cubic feet per capita.

Exports.—The export of timber from the French Congo has developed very rapidly. In 1898 the value of the export was estimated at $96,500 and the amount was only 144,300 cubic feet. Ten years later, in 1908, it was valued at more than $772,000. The export from 1909 to 1913, inclusive, was as follows:

	Cu. ft.
1909	2,079,550
1910	2,972,150
1911	5,112,000
1912	4,784,950
1913	7,534,400

In 1914 the export fell to 4,350,000 cubic feet and in 1915 to 950,000 cubic feet, owing to the difficulties encountered by exporters in their dealings with navigation companies which did not care to transport timber during the war.

The most important export wood is okoumé or Gaboon mahogany, which fills about the same place as the cheaper mahoganies. Ninety per cent of the total wood export consists of this species. Other woods exported are ebony, mahogany, sandalwood, and camwood. Before the war the export trade of the French Congo was monopolized by the Austrian and German markets, and Hamburg was the port through which most of the important transactions were carried on. Of a total export of 7,534,400 cubic feet, representing a value of $1,605,613, in 1913, the last normal year, Germany alone took 3,358,450 cubic feet, or about 45 per cent. Table 361 gives more in detail the export for the years 1912 to 1916, inclusive, and shows the important place which Germany had in the commerce of wood from the French Congo and the Middle Congo.

These exports came chiefly from the French Congo, and only a small

TABLE 361.—TIMBER EXPORTS, FRENCH CONGO

Country of destination	1912	1913	1914	1915	1916
	tons	*tons*	*tons*	*tons*	*tons*
France	19,387	22,108	15,603	8,102	5,780
England	29,438	29,517	12,325	5,658	2,014
Germany	45,759	67,169	30,276	.....	.....
Spain	499	1,648	.....	.....	.....
United States	616	3,359	.....	180	268
Holland	.....	26,887	28,251	4,822	.....
Total	95,699	150,688	86,455	18,762	8,062

part of them from the Middle Congo. The principal ports of export are Cape Lopez, Libreville, Sette'-Coma, and Loango.

There is as yet no forest administration in the colony.

The Probable Future.—The timber business is capable of great increase with the development of transportation. It is estimated that only 10 per cent of the forest is now readily accessible. Growth is rapid. It is estimated that okoumé is ready to cut in 50 years, so that with careful management the Congo forests should be able to produce timber indefinitely. With an annual production of 143 cubic feet per acre, the 35,500,000 acres of equatorial forests of French Congo ought to be able to produce annually 5,076,500,000 cubic feet, much of which may in time be made available for export.

French Guinea

Forest Area.—The land area of French Guinea is 59,520,000 acres (93,000 square miles) and the population 1,812,000. The forests are estimated at 3,200,000 acres, or a little more than 5 per cent of the land area, and 1.8 acres per inhabitant.

Character of the Forest.—The coast is mostly densely forested, especially with mangrove. Inland are large areas of savanna, or park-like country, and bare mountains. Oil palm is the most important tree of the coast belt. Rubber, cola, gum-producing trees, and bamboos are abundant.

Exports and Imports.—The statistics of exports are fragmentary and inconsistent. In 1912 they are given as 170,000 cubic feet, valued at $7,816, and in 1913, 75 cubic feet, valued at $72.

Imports were about 1,000 metric tons, or 70,000 cubic feet, of construction material, worth $30,000. In the long run, exports and imports about balance each other.

Cut, Growth, and Consumption.—The annual cut has been estimated at 9,060,000 cubic feet, or an average cut per acre of 2.8 cubic feet. Firewood forms 95 per cent of this. The growth is probably equal to the cut. Since exports and imports balance, the total consumption is the same as the cut, namely, 9,060,000 cubic feet, or 5 cubic feet per capita.

The Ivory Coast

Forest Area.—The land area of the Ivory Coast is estimated at 80,000,000 acres; the population at 1,562,000. More than one-third (37.5 per cent) of the total area of the colony, or practically 30,000,000 acres, is covered by dense forests. This represents 19.2 acres per inhabitant. As a timber-producing colony, the Ivory Coast has an advantage over the French Congo in being nearer to the mother country. A railway has now been constructed from north to south, and many highways also have been built. As a result of these the region is being opened up.

Character of the Forest.—The dense tropical forest starts at the coast, and almost without a break covers more than 30 million acres. Beyond it, there is wooded brush land which gradually merges into the Sahara Desert. The forests of the Ivory Coast contain a great number of species of commercial and industrial value. The average stand per acre is 2,000 cubic feet of exploitable wood, although it reaches as high as 3,600 to 4,300 cubic feet. The total stand is 60,000,000,000 cubic feet. It is estimated that these forests contain at least 300 good commercial woods, including mahoganies and similar cabinet woods, teak-like woods, white woods (similar to basswood and poplar), and very light fibrous woods suitable for paper pulp. It is considered that about half of the species have a density, dry, of less than 0.50. Some of the principal commercial species of the Ivory Coast are:

African mahogany (*Khaya ivorensis*).—An excellent timber for general purposes. Very well known. Proportion in forest, 5 per cent.

Azobe (*Lophira procera*).—Carpentry, ships, railway coaches. Proportion, 18 per cent.

Avodiré (*Antiaris toxicaria*).—Substitute for yellow poplar. Excellent cabinet wood. Proportion about 10 per cent.

Hetéré or Ivory Coast okoumé (*Canarium occidentale*).—Resembles *Khaya*. Suitable for cabinet making, joining, etc. Proportion, 5 per cent.

Fakpo.—A leguminous species, probably an *Albizzia*. Substitute for walnut. Varnishes well. Cabinet work, joining. Proportion, 4 per cent.

Nété (*Piptadenia*?).—Wood resembles oak. Joining, carpentry, wagons. Proportion, 10 per cent.

Badi (*Sarcocephalus pobeguini*).—Cabinet work. Finishes well, very handsome wood. Proportion, 10 per cent.

Odoum (*Chlorophora excelsa*).—Works well. Substitute for teak. Railway coaches, joining, carpentry. Proportion, 5 per cent.

Meraut or parasolier (*Musanga smithii*).—Saws easily; suitable for paper pulp.

Serama (*Triplochiton scleroxylon*).—Very large tree, wood light, soft, elastic. Suitable for pulp. Also works well. Superior to linden and poplar.

Sougue (*Albizzia rhombifolia*).—Similar to oak. Proportion, 6 per cent.

Mangroves (*Rhizophora*).—Tanbark and crossties.

Of these species, 50 per cent are classified as hard wood, 35 per cent as semi-hard, and 15 per cent as soft.

Until the last few years mahogany was the only timber cut, and when it first appeared in 1895 at the markets of Havre and Liverpool it was looked upon with suspicion.

Cut, Growth, and Consumption.—The annual cut has been estimated at 9,398,000 cubic feet, of which 21 per cent is saw-timber. This is an average of only 0.3 cubic foot per acre. Since the forest is almost entirely in virgin condition, in which growth and decay balance, the net increment does not exceed the cut. Since there is an excess of nearly 1,600,000 cubic feet of exports over imports, the total consumption may be placed at 7,810,000 cubic feet, or 5 cubic feet per capita.

Exports and Imports.—The first important exportations of mahogany from the Ivory Coast, in 1899, amounted to 335,000 cubic feet. In 1910 the export of mahogany reached 689,150 cubic feet, and for the three years before the war, 1911-13, it was as follows:

Year	Cu. ft.	Value
1911.....	1,190,600	$436,619
1912.....	1,524,500	559,030
1913.....	2,132,600	967,484

The principal markets before the war were France, England, the United States, Germany, and Belgium.

Considerable quantities of many other species have been shipped to France in the form of logs. The Paris-Lyons-Mediterranean railway company has used them in manufacturing coaches, and furniture made from these woods has been exhibited at Roubaix, Brussels and Lyons. The French colonial foresters claim that the important commercial species other than mahogany are suitable for wagon-making, shipbuild-

ing, and fine cabinet work. Meanwhile, however, pine construction timber is being imported into the colony at the rate of about 25 to 30 thousand cubic feet a year. The principal exporting ports are Grand Bassam, Grand Lahou, Assinee, Half-Assinee, Sassandra, and Pontadoon.

Secondary Forest Products.—Other forest products of the Ivory Coast are palm oil, rubber, and kola nuts. Exports of palm oil average between 5,000 and 6,000 tons, and palm kernels from 3,000 to 4,000 tons a year. An equal amount is used locally. The average export of rubber is about 1,500 tons. Kola nuts will probably be important in trade in the future, since the tree is very abundant.

The Probable Future.—Although exports fell off during the war, there is every prospect that the forest resources of the colony will be further developed and that other valuable commercial woods besides mahoganies will find their way to the market. One of the plans for the near future is the utilization not only of mahoganies but of all the colonial timbers. This will be possible when these woods become more familiar on the European and other markets. Clear cutting of the colonial forests will result, it is expected, in a considerable reduction in the price of cabinet woods. The prices of cabinet woods under the old system, when the export was limited to mahogany, were very high. Mahoganies form hardly one per cent of the exploitable species, or 1 to 2 trees to 12 acres. Therefore when a logging road a quarter of a mile long and 13 feet broad has to be made to transport only one tree, the cost naturally is high. The net price for cabinet woods alone, delivered at the wharf of Grand-Bassam, when single trees were cut, was $19 per ton. Under a clear cutting system, when all the timbers are exploited, it would be only $8 per ton, or, adding $3 if the timber is to be squared, a total of $11. The price of all woods would then be $8 a ton for logs delivered at Grand-Bassam, or about 15 cents per cubic foot.

Madagascar

Forest Area.—The land area of Madagascar is 145,920,000 acres; the population is 3,545,000. The total forest area is placed by Perrier and Louvel, both of whom had been in Madagascar for more than 10 years, at 23,500,000 acres, or 16.1 per cent of the land area. This area is very much overestimated, however, as it does not represent true forest throughout. Only 7,500,000 acres may be considered as dense forest, rich in commercial timber. Ten million acres is covered with forest of medium density, 5,000,000 acres with scrub, and about 1,000,000 acres with mangrove, rafia, and ravenala. The per capita area of commercial forest is only 2.1 acres. It is estimated that the stand of timber is 3,500 cubic feet per acre in the dense forest, and 1,400 cubic feet in the forest of medium density. This represents a total volume of about 40

billion cubic feet of timber for the entire area of 17,500,000 acres of real forest.

Character of the Forest.—The most extensive forests are found on the eastern and northwestern coasts of the colony, especially in the provinces of Analalava, Vohemar, Maroantsetra, Tamatave, and Andovoranto. The high plateaus were formerly covered with a dense forest, but are now denuded except for groves of trees in Tsiafajavona, Tsinjoarivo, and Ambohitantely. The southern part of the colony contains only a few clumps of thorn growth in the region known botanically as the cactus zone of the south, and which M. S. Gautier has picturesquely called the "museum of plant horrors."

The densest forests are found in the region of Maroantsetra, on the east coast, where the rainfall is over 100 inches per year. The forests of the west coast, growing on permeable alluvial soil at low altitudes, where the rainfall is only 20 inches, are much less dense.

Beginning in the north in the province of Diego-Suarez, the forest belt continues wide through the province of Vohemar and touches the borders of that province and of Analalava and Nossi-Bé. Then it grows narrower from Maroantsetra to Tamatave. Between the coast and the vicinity of Lake Alaotra, it is about 46 miles wide. From Tamatave southward, the belt gradually narrows, and the wooded portions crowd closer and closer to the slopes of the mountain range. Toward Mananjary there remains only a fringe a few miles wide, and this continues to Fort Dauphin with larger and larger gaps in the province of Farafangana.

In the southwest, the forest gives place to brush vegetation adapted to dry conditions, with occasional specimens of tamarind or baobab. In the center the forest disappears with the exception of scattered trees. In the western region there are forests of more or less sparse growth, alternating with brush. In the province of Morondava, a few timbered areas still existing on the sides of the Bongo-Lava mountains form the curious forest of Antsingy, which is known for its strangely sculptured rocks. Along the rivers are the forests of Morondava, Tsiribihina, and Manambolo. In the provinces of Maevatanana and Majunga the only remaining forest vegetation is in isolated clumps. The island of Nossi-Bé, formerly entirely covered with forest, is now denuded except for the single forest of Lokobe. In the province of Analalava and on the "Grande-Terre," the forests have remained fairly dense and form a continuation of those of the east coast.

The timber of Madagascar, from the standpoint of utilization, may be classified as follows:

Cabinet woods.

Marquetry (for inlaid work) and turning woods.

Construction timber.

Woods suitable for manufacture of vehicles.

Woods suitable for railroad ties.

Cabinet Woods.—Rosewood (*Dalbergia*).—Native names, volombodimpona and andramena. Grows to 165 feet in height in the forests bordering the lakes. Fairly common in the coast forests of the bay of Antongil. Has also been found in the province of Farafangana, where it is used in making coffins of the chiefs. Wood very heavy, hard, fine-grained. Sapwood white, heart somewhat oily, with a slight odor of rose. Wood colored pale red. Used for manufacture of high-grade furniture, especially inlaid period furniture. Rosewood is exported in logs measuring 4 feet in length and 4 to 6 inches in diameter. The sapwood is removed from these logs.

Ebony (*Diospyros*).—Several varieties under different native names. Grows on the east coast, chiefly in the provinces of Maroantsetra and Vohemar. Also found on the west coast in the region of Majunga, Morondava, and Tulear.

Violet ebony (*Dalbergia*).—Known under the native names of voamboana and hazovola; reaches a height of 50 feet. Very widely distributed in the forests of Madagascar. Wood greyish violet, hard, dense, fine-grained. Sapwood of very poor quality. Exported in large logs to Europe, where it commands a price of $31 to $35 per ton.

Mahogany (*Eugenia*).—Also called rotra mena. Found in the forests of the bay of Antongil, Analamazaotra, Betsiriry, Boeni, Menabe.

Nato (*Sapotaceae* family).—Reddish-yellow wood, fine-grained, easily worked; found in all the forests.

Mango.—Reddish chestnut color, hard, impervious to decay.

Hintsina (*Afzelia bijuga* Gray).—Wood red, hard, dense, decay proof. Abundant in the coast region of the east.

Ambora (*Tambourissa parvifolia* Bak).—Wood a handsome spotted yellow, fairly light and easy to work. Odor resembles that of sandal wood.

Marquetry and Turning Woods.—Anjanajana.—Fairly common in the forests of the east. Reaches a diameter of 12 inches and a height of 40 to 46 feet. Color pale rose, very hard, fine-grained, twisted fibre. Decay proof, hard to work.

Manoka.—Reaches 16 inches in diameter and 45 feet in height. Wood yellowish, close-grained, hard, dense; resembles boxwood.

Zahana.—Reaches 16 inches in diameter and 50 feet in height. Wood yellowish, hard, and dense.

Harahara.—Wood extremely hard, veined with black and brown on a yellow ground. Very much in demand for the manufacture of tool handles.

Construction Timber.—A large number of species are available for

this purpose, among them harina, lalona, hazomena, mankaleo, merana, molompangady, tavolohazo, varongy, volomborona, hasina, etc. (native names).

Woods for Vehicles.—The best species for this use are: fontona, gavoala, and volanirana all of which are common in the forests of the east coast.

Woods for Railway Ties.—Preferred species are: asy, hintsina, copal tree (mandrorofo), vahona, merana (of the coast), vivaona or mankabo (variety of violet ebony), longotromena, and herihitsika or hazomena.

Woods for Packing.—Several species of light wood such as tavolo, varongy, volomborona, famelona, hetatra, hazondrano, ramy, voanana, vantsilana, and landemy lahy, could be used in the same way as poplar, alder, and birch for all uses requiring a light, easily worked wood.

Most of the forest species of Madagascar are as yet unidentified botanically. There is a vast field for scientific investigation and for activity on the part of foresters.

Secondary Forest Products.—*Rubber.*—Chief of these is caoutchouc, obtained from trees and lianas, most of which belong to the *Mascarenhasia* and *Landolphia* families. The trees are fewer in number than the lianas. The cactus region contains intisy (*Euphorbiaceae*), and the forests of the east and west, barabanja, guidroa, and hazondrano. The lianas are very numerous, and furnish the two best grades of Madagascar caoutchouc: "rose" or "pinky Tamatave," and "Majunga superior."

Copal.—This is the resin which flows from the trunk, branches, and roots of the copal tree (mandrorofo). This tree (*Trachylobium verrucosum*) is found exclusively in the sandy coast region. It is abundant throughout the northeastern coast, but the region of Vohemar produces the best grade. There are also other resins or gums exuded by *Dalbergia boriensis,* a variety of violet ebony which produces black, brilliant, brittle resin, soluble in alcohol and producing in combination with alcohol a red varnish; and by *Khaya madagascariensis, Trachylobium* species, and *Canarium* species.

Vegetable Fiber.—Produced by a palm (*Dictyosperma fibrosum.* Native name vonitra), which is abundant on the east coast, especially in the Betsimisaraka region. It is obtained from the ligneous fibre of the spathes of the inflorescences, and is exported under the name of piassava and used in making all kinds of brushes. Other vegetable fibers are manarana, used in making hats, and avohana, used in manufacture of "antaimorona" paper.

Exports.—The exports of timber are very small at present, including only a few species, chiefly ebony and rosewood. Ebony is represented by several species of *Diospyros,* which the natives call hazomainty.

The exploitation of the forests is hindered by inadequate means of

transportation within the island and by the difficulty of access to the island itself.

Export from Madagascar in 1913 amounted to only 323,700 cubic feet, valued at $160,552. In 1912 the export was 281,400 cubic feet, valued at $111,356.

Cut, Growth, and Consumption.—No data are available on these points. The annual cut has been estimated at 35,753,000 cubic feet, or 1.5 cubic feet per acre. Firewood forms the bulk of the cut, or 94.5 per cent. The forests are being destroyed by cutting, clearing, and fires faster than they grow. The net growth, therefore, is nil. The total consumption, allowing for the 303,000 cubic feet which is exported, is 35,450,000, or 10 cubic feet per capita.

Forest Destruction and Its Causes.—As a result of fire, the original species of the forest have largely disappeared. Perrier estimates that 95 per cent of the former species have disappeared because of fires and reckless cutting. Brush fires, together with the native method of cultivation and cutting, have destroyed three-fourths of the forests of the island and have brought about a complete change in the aspect of the vegetation. The native flora of Madagascar was arborescent, but under the action of fires it has given place to brush, which in its turn, as a result of further fires, is replaced by prairie vegetation on the plateaus and in the west, and on the east coast by ravenala, bamboo, or a brush growth resistant to fire. Destruction of the forest by the natives has gone on unchecked. When a native needs wood he selects the tree which suits him and cuts it. If he then finds it unsuited to his purpose he leaves it to decay and cuts another. It frequently happens that in order to get a single tree 4 acres of forest is destroyed.

Forest Legislation.—The reduction of the forest area from some 50 million acres in 1906 (probably an overestimated figure) to 23,500,000 acres at present, or less than one-sixth of the total area of the country, has caused the provincial government to undertake investigations of the effect of forest destruction upon the climate of the island of Nossi-Bé. The investigating committee reported a gradual decrease in rainfall and a resulting irregularity of the seasons. The water supply has decreased so greatly as to be a matter of serious concern to the inhabitants of Helle-Ville. The same is true of Madagascar. On the plateaus the results of deforestation are apparent in extreme climatic conditions: irregular rainfall, violent winds, low temperature followed at short intervals by intense heat, and sudden freshets.

The government has now adopted protective measures against further forest destruction. Brush fires for the purpose of renewing pasture land are prohibited, as well as the native method of promiscuously clearing forests for agricultural use. Some forests have been reserved along the

railway; in a number of provinces other forest areas have been reserved. Forest management on a small scale has been attempted with fairly good results. Some reforestation is being done by the government. The species used in planting are chiefly eucalypts and pine, eucalypts being the most successful. There is also a law which classifies different kinds of timber to be cut and specifies conditions on which cutting may be done.

The Probable Future.—While Madagascar will probably continue to export moderate quantities of wood for cabinet work and other special uses, it is not likely that there will ever be a large surplus of timber available for export. Much of the more accessible forest has been destroyed, and domestic requirements for timber are bound to increase.

Mauretania

The Atlantic end of the Sahara, called Mauretania, has a land area of 220,778,880 acres (344,967 square miles), and a population of 256,000. It is a more or less desert-like grazing country, with no trees except around water-holes or on small cultivated areas.

Morocco

Forest Area.—The land area of Morocco is 142,614,400 acres. The forest area is estimated at approximately 3,700,000 acres, or 2.6 per cent of the land area. With a population of 5,400,000, this represents 0.7 acre per inhabitant.

Character of the Forest.—The forests of Morocco are similar to those of Algeria and Tunisia—cork, holm oak, Aleppo pine, thuya, and juniper—yet a number of species are found in both Morocco and Portugal which are lacking in Algeria. This would indicate the Atlantic character of the forest flora of Morocco. Another peculiarity of Morocco forest vegetation is its vigor and luxuriance, which has enabled it to withstand devastation by the natives.

According to species the forests are distributed as follows:

TABLE 362.—CHARACTER OF FOREST, MOROCCO

Species	Area	Species	Area
	acres		*acres*
Argan	1,111,500	Evergreen oak	370,500
Cedar	741,000	Juniper, pines, etc	370,500
Cork oak	617,500	Total	3,705,000
Thuya	494,000		

The forests are not distributed uniformly over the entire area, but are concentrated in four well-defined zones. These zones are:

1. The zone of cork oak and thuya. This includes several forests. The most important is that of Mamora (321,100 acres); then come the forests of Azers (39,520 acres), Sehouls (19,760 acres), Camp Boulhaut (31,616 acres), Ain Kreil (19,513 acres), M'Krenza (8,645 acres), Maahif 12,350 acres), N'Kreila and Bou-A-Azine (12,350 acres), and several others. The total forested area of the region is approximately 1,111,500 acres.

In most of these forests cork oak is of vigorous growth. The trees usually reach 8.2 feet in circumference at about 55 to 60 years, and 28 inches, or cutting size, at about 25 years.

Thuya is found in the same zone along the Korifla, on the slopes of the *oueds*. The total area of the thuya stands may be estimated at about 494,000 acres. This wood is an important article of commerce among the natives, who use it for cabinet work such as that sold at Sale, Rabat, and Mogador. It is also used for small carpentry. The thuya in the forest of Korifla is exploited in a rational way by the Forest Department.

2. Zone of the Central Atlas—cedar and holm oak. This zone lies in a northeast by southwest direction between Anoceur and Kasbah-Tadla. It extends to the southeast as far as Moulouya, in parallel strips 6 to 9 miles in width. Generally speaking, the oak forest begins at an altitude of 3,700 feet. Cedars are found only at 4,100 feet or more, and become abundant higher up.

In the oak forests of the Central Atlas, holm oak and zeen oak are found in the proportion of 10 to 1. Holm oak, which covers 370,500 acres, yields heavy wood suitable for railway ties and wagons. Zeen oak, which resembles French oak in quality, is suited to the same uses as holm oak.

The cedar forests furnish coniferous timber adapted to use in carpentry. While part of the cedar forest is still located in unexplored territory, its area is estimated at not less than 741,000 acres. Some of the trees are 6.5 feet in diameter and 130 feet high.

3. Great Atlas zone. The forest zone of the Great Atlas is as yet little known. It is only known that in the mountainous region from Kasbah-Tadla to Mogador and Souss there are fairly large stands, consisting chiefly of holm oak, Aleppo pine, thuya, and cedars in the northeastern part. These forests are extensively exploited by the natives. The time is probably not far distant, however, when it will be possible to make systematic use of them. The area of the forests is estimated to be somewhere between 370,000 and 710,000 acres.

4. The zone of the argan tree. This tree, which is peculiar to Morocco, is the only species of the genus *Argania*. The forests of this

zone are located in the coastal regions of Mogador and Agadir, and extend some distance into the valley of the Souss, on the spurs of the Great Atlas and the Anti-Atlas. The forests are located within 100 miles from the coast. They were carefully examined during the winter of 1917-18. The growth is sparse at the south of Safi and rather extensive in the vicinity of Mogador, where argan is mixed with thuya. Farther south begins the true argan forest, which extends to the coast region of Tazeroualt and to the Noun *oued*. The scattered nature of the growth of this zone makes it impossible to determine the area exactly. It has been variously estimated at from 750,000 to 1,111,500 acres.

At the present time these forests, which have the advantage of growing well in poor calcareous soil, furnish food to the Cheul population. The tree bears a nut from which oil resembling olive oil is obtained. If extraction of the oil by industrial processes proves successful, it is likely that the argan forests will eventually be an important source of revenue for the protectorate. The wood of the argan tree is heavy, compact, and very hard. It does not seem well adapted to industrial uses, except perhaps where great strain must be endured; on the other hand it is an excellent fuel wood, and as such is exported in considerable quantities to Tangier and Casablanca. The argan zone is also rich in thuya, which is used in the native cabinet work of Mogador, and which also produces, under a certain process of tapping, a resin called sandarach, used in pharmacy as well as in the manufacture of varnish.

Cut, Growth, and Consumption.—No complete statistics of the cut are available. During 1917, 50,000 planks, representing 176,500 cubic feet, were sawed. In 1918, 247,100 cubic feet of standing timber (cedar and holm oak) was sold at $0.19 per cubic foot, and at the end of that year new cuttings were contracted for to the amount of 353,000 cubic feet. Three sawmills with modern equipment are operating at Azerou and Ain-Leuh.

The total annual cut has been estimated at 27,000,000 cubic feet, or 7.3 cubic feet per acre. Saw-timber forms but a small part, or 5 per cent, of the entire cut. The growth is probably equal to the cut. The total consumption, including the 1,624,000 cubic feet of imports, is estimated at 28,624,000 cubic feet, or 5.3 cubic feet per capita.

Exports and Imports.—Immediate exportation of Moroccan woods is impossible. Cork oak and argan, which because of the geographic location of the forests in which they grow could be more or less conveniently transported to shipping ports, must serve local demands. Only the great cedar forests of the Central Atlas can furnish a valuable supply of building timber, and the difficulties of exploitation and communication are obstacles to its exportation, at least for the time being.

In 1913, Morocco imported 2,824,000 cubic feet of wood for its own

consumption. This import dropped to 1,623,800 cubic feet in 1914 and 423,600 cubic feet in 1916. It is expected that the imports will diminish still more when the present systems of roads and railways are extended and automobile transportation is developed. Even now, motor trucks are being used to carry wood to Meknes, where it is loaded on freight cars. This method of transportation is cheap and rapid.

The Cork Industry.—The annual yield of the largest forest of cork oak, that of Mamora, is estimated at 21,000,000 pounds. The other forests may yield about 4,200,000 pounds a year. The total production would reach about 25,200,000 pounds, which, at $.034 to $.040 per pound, represents $850,000 to $1,000,000. From this the cost of production, transportation, and hauling must be deducted. This amounts to $.004 to $.008 per pound, or $176,400 to $201,600. About 350,000 trees have already been worked.

Most of the cork is exported. Up to the present time it has been carried on the back of mules to the shipping ports, at a cost of $.006 per pound. This cost can be reduced to $.003 by making use of the railway and the two roads from Babat to Meknes.

Forest Administration.—In 1913 a Department of Forests and Waters was created. It is concerned with the exploitation of existing forests, planting, and introduction of exotic species. Although the department has existed but a few years, the results of the first working year, 1914-1915, were very encouraging and the receipts of the department have almost equaled the expenses. The cork oak forests of Mamora, as well as two other forests which were being rapidly destroyed by the natives, have been put under control. About 60 miles of fire lines nearly 100 feet wide have been constructed. A number of houses have been built for the accommodation of French and native staffs. The income from the state forests increased from $112,050 in 1914-1915 to $171,944 in 1915-1916, and $314,435 in 1916-1917.

The Probable Future.—The outlook for forestry in the protectorate is satisfactory. Morocco will soon be able not only to supply her own needs but to export timber as well.

The forests of the Central Atlas are of great importance for the future. They will supply large quantities of railway and mine timber which could never be secured from abroad, because of transportation costs and the state of exhaustion of the forests of Europe and America. Coniferous timbers are most in demand. Morocco, with its 741,000 acres of cedar forest, is well able to meet this requirement. As soon as the regions of Aaia and Beni-Ouarain are pacified it will be possible to proceed with exploitation of their vast forests on a large scale. These forests will probably yield 14,120,000 to 17,650,000 cubic feet of coniferous timber annually, which will be exported to France. The Central

Atlas region also contains large stands of Phoenician juniper, which can be used as a substitute for American woods in the manufacture of pencils.

Woods of the Central Atlas which are to be exported will be carried by rail from Azrou and Ain-Leuh to Meknes, and from Meknes to the shipping point. The roadbed for the branch from Meknes to Azrou has already been planned, and the necessary appropriations have been made, while the road from Meknes to the ports is already in operation.

Sahara Territories

The same condition which exists in Mauretania is found in the vast interior of the Sahara region. Palms are numerous in the oases, and yield fuel, food, fibers, clothing, and oils.

Senegal

Forest Area.—The land area of Senegal is 47,367,680 acres, and the population is 1,444,600. The forest area is estimated at 950,000 acres, or 2 per cent of the land area, and 0.7 of an acre per inhabitant.

Character of the Forest.—The coast is skirted by sand dunes, and is desolate except to the south, where there is heavy mangrove forest. Between the Senegal and Gambia rivers eastward to the 13th meridian is mostly barren plain, with forest along the rivers. In Upper Senegal, west of the Niger, are mountain forests which contain a large variety of valuable trees.

Exports and Imports.—The exports are practically negligible, amounting in 1912 to 200 cubic feet valued at $54, and in 1913 to 25 cubic feet valued at $15. The imports of wood amounted in 1905 to 440,000 cubic feet, mostly long-leaf and other pine and fir construction lumber, valued at $165,000.

Cut, Growth, and Consumption.—The annual cut has been estimated at 4,334,000 cubic feet, of which 95 per cent is firewood. The growth is probably equal to the cut. The total consumption, including the 440,000 cubic feet which is imported, is 4,774,000 cubic feet, or 3.3 cubic feet per capita.

French Somaliland

French Somaliland has a land area of 3,705,600 acres (5,790 square miles), and a population of 206,000. It is a barren country, with a few trees along water courses and a small number of thorn trees scattered in the scrub. There is no commercial forest. The total consumption of wood, which is almost negligible, consists for the most part of firewood cut locally.

Tunisia

Forest Area.—The forest area of Tunisia is relatively small. With a total area of 32 million acres, in 1914 forests covered only about 3 million acres, or 9.4 per cent. The per capita forest area is only 1.5 acres.

Character of the Forest.—The forests are located largely in the coast districts and on the Atlas Range, which extends into the western part of the province. Over 300,000 acres is covered with cork oak, which is managed for its cork and yields practically no timber except firewood. Zeen oak, which yields tie timber especially, occupies about 25,000 acres. There is plenty of this material to meet all probable future demands for ties. Other species in the coast regions are olive, ash, elm, myrtle, pistachio, walnut, alder, poplar, mulberry, acacia, willow, and laurel.

The mountain forests of the Atlas Range contain large areas of Aleppo pine and Phoenician cedar. Most of these forests are rather thin, and are more valuable for protection than for timber. They do, however, supply much of the native demand for wood for houses, tent poles, and vehicles.

The state forests of the regency may be divided into two groups.

The northern group includes the mountain range of Kroumirie, Nefze, and Mogod. The forests of this group are composed principally of cork oak and zeen oak, and extend over 370,500 acres. These two species cover the higher portions of the mountains. Wild olive grows on the slopes, and in the valleys are elm, ash, poplar, and willow.

The forest group of the southern part of the Medjerda is much less dense, and is composed chiefly of holm oak and Aleppo pine, mingled with wild olive, carob, thuya, and juniper. Its extent is about 2,099,500 acres.

Character of Ownership.—Of the forest area, 175,000 acres, or 5.8 per cent, is privately owned, and 2,825,000 acres, 94.2 per cent, belongs to the government. This growth of the area of state forests is phenomenal, since in 1903 their total area did not exceed 37,050 acres.

Cut, Growth, and Consumption.—The cut has been estimated at 8,550,000 cubic feet, or 2.9 cubic feet per acre. Of this only 13 per cent is sawtimber. The growth is probably equal to the cut. The total consumption, including 1,710,000 cubic feet which is imported, amounts to 10,260,000 cubic feet, or 5.3 cubic feet per capita.

Exports and Imports.—The exports of wood for 1912-13 are shown in Table 363.

A large quantity of tanbark from cork oak is exported to England, Portugal, and Italy.

Imports of wood average approximately 2½ million cubic feet per

year. Oak for barrels is an important item of import, as are also coniferous construction woods.

The Tunisian forests have been under regulation for the past 35 years.

Cork Oak.—Cork oak occupies an area of about 247,000 acres, and in the region of Kroumirie forms splendid forests, the exploitation of which is easy because of their proximity to the sea and to railroads.

TABLE 363.—WOOD EXPORTS, TUNISIA

Product	1912		1913	
	Amount	Value	Amount	Value
	cu. ft.		*cu. ft.*	
Building material (oak), rough, squared, or sawn, exported principally to Algeria.	156,773	$ 34,288	450,325	$ 98,485
Building material (other than oak), rough, squared, or sawn	71,755	13,731	12,593	2,410
Cabinet woods, thuya and others	104	142	25	35
Other woods	660,588	127,130	228,002	33,503
	889,200		690,945	
	tons		*tons*	
Cork, crude, or in semi-manufactured condition	4,589	309,993	7,362	497,291
Total value	.....	$485,284	.....	$631,724

In 1908 Tunisia exported 8,818,400 pounds (4,000 tons) of raw and semi-manufactured cork valued at $191,649, and 9,552,500 pounds (4,333 tons) of tanbark valued at $250,900. Tunisia possesses about one-fifteenth of the total cork oak forests of the world.

The Tunisian Forest Service has estimated that there are 10 million trees producing cork oak, and 1,412,560 cubic feet of zeen oak, not counting branchwood.

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GERMAN COLONIES IN AFRICA

(Before 1914)

Former German colonies in Africa include Togoland, Cameroon, Southwest Africa, and German East Africa. These colonies have a total area of approximately 596,000,000 acres, 11,500,000 population, and 46,000,000 acres of forest. The total stand of timber is roughly estimated at from 125 to 150 billion cubic feet, of which from 35 to 40 billion is saw timber.

The only one of these colonies which has a large surplus of wood and can be counted on as a potential exporting region is Cameroon. The others can probably largely supply their own needs, except that with a heavy increase in population and industry southwest Africa would not have enough timber.

Under a mandate of the League of Nations the western strip of Togoland is being administered by Great Britain and the higher and cooler eastern districts by France. Cameroon has also been transferred under the mandate system to France and Great Britain (France controls all except a small portion west of the mountain range, which is now joined to British Nigeria). Southwest Africa has been turned over to the Union of South Africa, and German East Africa, now known as Tanganyika Territory, to Great Britain, except for a small portion ceded to Belgium.

The forest situation in the former German colonies is summarized in Table 364.

Cameroon (French and British Mandate)

Extent of the Forest.—The total area of forests in Cameroon is estimated at 35,000,000 acres. This is 28.6 per cent of the land area and 13.8 acres per inhabitant. The area of virgin forest, however, is only about 25,000,000 acres. The volume of virgin standing timber is estimated at 88¼ billion cubic feet, or 3,500 cubic feet per acre. Actual measurements in the most accessible areas showed that 65 per cent of the stand is of immediately utilizable species.

TABLE 364.—FOREST SITUATION IN FORMER GERMAN AFRICA

Country	Total land area	Population	Forest area			Productive forest area			Exports	Imports	Difference[1]
			Total	Per cent	Per capita	Total	Per cent	Per capita			
	acres		*acres*		*acres*	*acres*		*acres*	*M cu. ft.*	*M cu. ft.*	*M cu. ft.*
Cameroon:											
British	19,840,000	740,000	8,960,000	45.2	12.1	25,000,000	20.4	9.8	314	.....	+314
French	102,483,200	1,800,000	26,040,000	25.4	14.5						
German East Africa	245,875,200	7,700,000	9,600,000	3.9	1.2	620,000	0.3	0.1	.....	.....	.....
German Southwest Africa	206,208,000	200,000	1,000,000	0.5	5.0	1,000,000	0.5	5.0	.....	.....	.....
Togoland	21,568,000	1,032,000	340,000	1.6	0.3	150,000	0.7	0.1	6	60	−54
Total	595,974,400	11,472,000	45,940,000	7.7	4.0	26,770,000	4.5	2.3	320	60	+260

[1] + indicates exports exceed imports; − indicates imports exceed exports.

Character of the Forest.—The forest vegetation of Cameroon does not differ essentially from that of the Ivory Coast and the French Congo. The virgin forest at lower altitudes is typical tropical rain forest, which changes in character with increasing altitude, and finally merges into the "fog" forest in the higher mountains. The second-growth forest, which takes the place of virgin growth burned by the natives to obtain land for agricultural purposes, is characterized by the umbrella tree (*Musanga smithii*). This tree may prove to be suitable for pulpwood. The coast regions and the estuaries of the rivers are almost entirely covered with mangroves.

Exports.—Although there are about 40 species suitable for construction and other purposes and they constitute 76 per cent of the stand, only 3 or 4 species play any part in export trade—African mahogany (*Khaya*), ebony (*Diospyros*), red ironwood (*Lophira procera*), and okoumé or Gaboon mahogany (*Aucoumea*).

The mahogany of Cameroon is generally less highly esteemed as timber than that of the Ivory Coast, which is known as "Grand Bassam" mahogany.

Table 365 shows the approximate amounts of wood exported from Cameroon from 1905 to 1913, inclusive, and Table 366 gives the amounts of the different species exported in 1912.

TABLE 365.—WOOD EXPORTS, CAMEROON

Year	Cu. ft.	Year	Cu. ft.
1905	83,000	1911	360,200
1906	66,100	1912	564,500
1907	50,200	1913	1,142,350
1908	72,100		
1909	95,650		
1910	81,650	Average	314,469

Cut, Growth, and Consumption.—The installation of mechanical sawmills was begun in 1906, and two mills, with an annual capacity of 500,000 cubic feet each, are now operating in the part of the territory administered by England. The French mills are not in operation because of lack of labor.

The total wood consumption in Cameroon has probably averaged about 5 cubic feet per capita, of which 95 per cent was firewood. Allowing for the export of 314,000 cubic feet, the annual cut would be in the neighborhood of 949,000 cubic feet of timber and 12,065,000 cubic feet of firewood.

The Probable Future.—Cameroon presents excellent opportunities for a thriving timber industry. The forest resources are abundant and easily accessible, and two railway lines and several navigable waterways facilitate export. While the second-growth forest is extensively cut by the natives for the purpose of clearing the ground for agriculture, the virgin forest is free from this danger since the land on which it grows is not suitable for field crops. It is estimated that these forests can furnish at least 18 million cubic feet of timber annually, in addition to secondary products such as rubber, fibers, tanbark, extracts, and oils.

German East Africa or Tanganyika Territory (British and Belgian Mandate)

The forest area is estimated to cover 4 per cent of the territory, or about 9,600,000 acres. Most of this, however, is brush forest composed of small deciduous trees. Timber forests are estimated at about 620,000 acres, nearly all in government ownership. These are on the higher mountain slopes. Remnants of them are found in Usambara, Kilimandscharo, and Meru, in the Uguru and Uluguru mountains, and west of Victoria Lake. Another forest of commercial value is found in the fog belt at 3,500 to 10,000 feet elevation. There is some mangrove at the seashore, and forests follow the rivers in the plains, but they are of little value. The rain and fog forests are the only ones that furnish the basis for a wood trade.

TABLE 366.—EXPORTS FROM CAMEROON IN 1912, BY KINDS OF WOOD

Common Name	Scientific name	Quantity
		cu. ft.
Mahogany	*Entandrophragma, Khaya,* or *Carapa*	400,300
Alep	*Irvingia oblonga*	150
Azobe	*Lophira procera*	30,150
Bahia	*Mitragyna macrophylla*	2,300
Bilinga	*Sarcocephalus trillesii*	450
Bosipi	*Oxystigma mannii*	50
Ebony	*Diospyros* sp.	74,700
Fromager	*Ceiba pentandra* or *Eriodendron guineense*	11,750
Iroko	*Chlorophora excelsa*	4,350
Moabi	*Baillonella toxisperma* or *djave*	1,500
Noyer	(Sp.?)	5,900
Okoume	*Aucoumea klaineana*	29,300
Padouk	*Pterocarpus soyauxii*	550
Mangrove	*Rhizophora mangle* L	600
Others		2,500
Total		564,550

The mountain forests of Usambara and Pare are estimated to contain 85,000 acres of alpine forest, 50,000 acres of cedar (*Juniperus procera*), 75,000 acres of yellowwood (*Podocarpus usambarensis*), and 1,000 acres of mixed broadleaf species. Only *Chlorophora excelsa* (morac of Meoule, the African "oak"), the conifers *Podocarpus* and *Juniperus*, and *Khaya senegalensis* (African mahogany), at present furnish commercial timber.

Other timber trees are *Piptadenia buchanani* (Legum.) and *P. hildebrandtii, Albizzia fastigiata* (Legum.), *Parinarium goetzenianum* (Rosac.), *Chrysophyllum msolo* (Sapot.), and *Syzygium guineense* (Myrt.).

In the Uluguru Mountains the valleys are filled with rain forests up to 7,000 feet elevation. There *Podocarpus, Stearodendron, Ocotea usambarensis, Serindeia obtusifoliata, and Chrysophyllum ulugurense* are the leading species.

In the district of Kilimandscharo and Meru, some 300,000 acres of rain forest is found, with *Juniperus, Podocarpus* and *Chlorophora* the leading species, besides an unidentified ash-like tree (ljondo).

There is one mangrove area of about 35,000 acres, from which bark is exported.

Timber is exploited only for local use. Several sawmills are in operation, but most of the wood used in the country is for fuel. The total consumption is estimated at 30,800,000 cubic feet, or 4.0 cubic feet per capita.

German Southwest Africa (Now attached to Union of South Africa)

German Southwest Africa, lying 20° south of Cameroon, is practically forestless except for clumps of acacia brush and limited areas of forest along river banks. Only in the north are found some remnants of tree growth. The forests occupy about 1,000,000 acres, or 0.5 per cent of the land area. This is 5.0 acres per inhabitant.

The country may be divided into five zones: (1) the treeless strip along the sea coast, rising from the shore 2,300 feet and extending about 50 miles, from Orange to Kunene, with rarely more than 0.6 inch rainfall; (2) the bush forest of Hereroland, reaching 4,900 feet, with 3.9 to 23.6 inches rainfall, in which trees of large size rarely occur; (3) another low bush forest, Namaland, at about the same altitude, but with less rain, 2.4 to 9.1 inches; (4) the park-like forest of the eastern portion, in Kalahari and Omaheke, with taller tree growth in the river bottoms, reaches 3,900 to 4,600 feet elevations, and the amount of rainfall is unknown; and (5) the northern region, north of 20° south latitude, which bears, in contrast to the other four zones, almost dense forest

growth without thorn trees. This region extends up to 3,300 to 4,600 feet, and receives as much as 39.4 inches rainfall.

The colony imports most of its construction material. Firewood is furnished by the native scrub forests. The principal product of these forests, aside from firewood, is bark (for tanning) and acacia gums. The total consumption of wood is probably not over 800,000 cubic feet.

Before the war the German forest administration was engaged in planting on the plains. The species used were: *Pinus halepensis, P. canariensis, P. pinea, P. pinaster, Eucalyptus, Casuarina, Prosopis, Cupressus, Morus, Schinus, Ailanthus, Robinia,* cork oak, camphor tree and bamboo.

Togoland (British and French Mandate)

The small colony of Togo, or Togoland, to the west of the Cameroons, was the most prosperous of the German colonies. Formerly it was probably heavily wooded. At present only small remnants of forest on the north and south mountain range, and river forests are left—about 1 to 2 per cent of the total land area. The rest is uninhabited steppes with scattered scrubby trees, except for some 7,040,000 to 7,680,000 acres of inhabited agricultural country, part of which is devoted to growing oil palms. The steppe areas contain a large number of tree species, many of which would have commercial value if they were not so scattered as to make exploitation unprofitable.

There is estimated to be only 150,000 acres of virgin forest left, besides 190,000 acres of river-bank forest. This is tropical evergreen forest, with some 200 species of trees, including mahoganies (*Diospyros mespiliformis, Khaya klainii,* and *K. senegalensis*), African teak (*Chlorophora excelsa*), *Erythrophleum guineense* (furniture wood), *Borassus flabelliformis* (building timber), as well as a large number of *Leguminosae.* Only six of these are used to any great extent in the colony. Other species include kapok or silk cotton tree, African rosewood or coralwood, and shea-butter tree, which furnishes a fat used for butter and also in soap and candle manufacture.

Most of the wood now imported could be supplied by the forests of the colony, if modern sawmills were installed. The present hand sawing makes native lumber more costly and less satisfactory than imported material. About 204,000 cubic feet of construction material of all kinds is produced annually, while the consumption of firewood amounts to at least 4,902,000 cubic feet.

Imports (1906-1909) averaged nearly 1,000 metric tons per annum of construction material, roughly 60,000 cubic feet. Exports were about one-tenth of that amount. The total consumption amounts to about 5,160,000 cubic feet, or 5.0 cubic feet per capita.

The German Government maintained a forestry department in the colony, and some planting was done.

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INDEPENDENT STATES

The independent states in Africa include Abyssinia and Liberia. Their total and forest areas and population are given in Table 367.

TABLE 367.—FOREST AREA, INDEPENDENT STATES.

Country	Total land area	Population	Forest area		
			Total	Proportion of land area	Per capita
	acres		*acres*	*per cent*	*acres*
Abyssinia	224,000,000	8,000,000	14,820,000	6.6	1.9
Liberia	25,600,000	2,000,000	16,000,000	62.5	8.0
Total	249,600,000	10,000,000	30,820,000	12.3	3.1

Abyssinia

Abyssinia is a high plateau, comparatively bare, with trees and bushes thinly scattered. The glens and hillside ravines are often thickly wooded, mostly with extra-tropical hardwoods, including such species as date palm, mimosa, wild olive, sycamore, juniper, laurel, myrrh, fig, orange, and lime. The conifer, yellowwood, is also common in the mountains. These forests are characteristic of the northern mountains.

River forests follow the courses of the Nile tributaries, and are similar to the Sudan forests described on page 836.

In the mountains to the south are larger continuous areas of valuable timber, similar in character to the highland forests of East Africa. Yellowwood and mountain cedar are characteristic species.

Timber is used locally, especially for fuel. It is said that the absence of large towns in Abyssinia is due partly to the frequent change of the

royal residence as wood fuel supplies became exhausted. The total consumption must be at least 32,000,000 cubic feet, and may be much more.

Liberia

Forest Area.—Liberia is a republic under the nominal protection of the United States. It occupies a narrow strip extending from Cape Palmas on the east to the Mano River on the west, and comprises an area of 25,600,000 acres. It is bounded on the west by the British colony and protectorate of Sierra Leone, and on the north and east by the French possessions of Senegal and the Ivory Coast. The actual extent of the forests is not known. It is probable, however, that they cover the greater part of the country, like those of the Ivory Coast. The forest area is probably not less than 63 per cent of the land area—16,000,000 acres, or 8 acres per inhabitant.

Character of the Forest.—The forests are similar in character to those of Sierra Leone and the Ivory Coast. One of the best known is the Gola forest on the western boundary, contiguous to the Sierra Leone protectorate. It is about 160,000 acres in extent.

The chief species of trees suitable for export are the following: Mahogany (*Khaya ivoriensis*); satinwood (*Afrormosia laxiflora*); African oak (*Oldfieldia africana*); real satinwood (*Zanthoxylum macrophyllum*); African walnut (*Lovoa klaineana*); African pearwood (*Mimusops lacera*); iroko (*Chlorophora excelsa*); and red ironwood (*Lophira procera*). These species have been exported in the log from various parts of western Africa. There are, however, several other trees which might be cut and exported. They are: white mahogany (*Canarium schweinfurthii*); Rhodesian mahogany (*Afzelia bracteata* ?); red oak (*Berlinia auriculata*); brimstone (*Morinda citrifolia* ?); and several others. There are probably about 100 different kinds of woods, many of which could be cut for local use, at least.

There are other products, such as oil beans, obtained from *Pentaclethra macrophylla,* a large forest tree; gum copal, obtained from *Daniella ogea,* one of the largest forest trees; and palm oil and kernels from the oil palm (*Elaeis guineensis*), which is found in all the clearings. Piassave, obtained from *Raphia vinifera,* is found on the banks of the two rivers, Morro and Mano. Rubber could be obtained from the African rubber tree (*Funtumia elastica*) and various rubber vines, such as *Landolphia owariensis* and others. Dika nuts could be procured, as the tree which bears them, *Irvingia barteri,* is commonly found. Tallow tree (*Pentadesma butyracea*), which bears a large number of oil-producing nuts in its large fruit, and dita (*Detarium senegalense*), which yields a mango-like fruit, eaten locally, are also common.

Bitter kola (*Garcinia kola*) is found, but is not often sold in the local

market. The rough-skinned *Parinarium excelsum* yields a fruit which is eaten locally; African star-apple (*Chrysophyllum africanum*) is found in the forest, and also planted. In certain villages akee, obtained from *Blighia sapida,* is quite common in the forest, though the edible fruit is not used. Mackay or sea bean (*Entada scandens*) is a huge creeper which grows to 350 feet in length and 3 feet in girth.

Exports and Imports.—The chief exports at present are palm kernels and palm oil, rubber and piassave. In 1908 these had a total value of $882,571, but dropped in 1912 to $252,939. Some mahogany has been exported from the port of Sinoe. A large part of the construction timber used in the colony is imported, because the forests are not systematically managed nor exploited. Except for one or two small, poorly equipped sawmills connected with missions, timber cutting is done by hand. Most of the imported timber is yellow pine from the United States, which comes via England, Germany, or the Canary Islands.

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ITALIAN AFRICA

Italian colonies in Africa include (a) Eritrea and (b) Somaliland on the east coast, which have no commercial forests, but only narrow wooded strips along the water courses; (c) Tripoli and Cyrenaica, or Libya. Their total and forest areas and population are given in Table 368.

Table 368.—Extent of Forests, Italian Africa

Colony	Total land area	Population	Forest area		
			Total	Per cent of land area	Per capita
	acres		*acres*		*acres*
Tripoli and Cyrenaica	259,840,000	1,000,000	2,500,000	1.0	2.5
Eritrea	29,312,000	450,000	[1]	.....	.....
Italian Somaliland	89,235,200	650,000	[1]	.....	.....
Total	378,387,200	2,100,000	2,500,000	0.7	1.2

[1] No commercial forest.

Tripoli and Cyrenaica (Libya)

The forests of Tripoli form the eastward extension of the North African Mediterranean forests which are found in Morocco, Algeria, and Tunisia. The species are the same as in those countries—cork and evergreen oaks, wild olive, acacia, and pistachio, with alders, willows, poplar, tamarisk and similar species in the valley bottoms. On the higher ground are laurel, myrtle, and other hardwoods, and Aleppo pine and Phoenician juniper. Never having been subjected to forest management, these forests have been very heavily overcut and seriously damaged by fires and overgrazing. Their especial value is as protection forests, though they can probably supply firewood and similar material for local needs. The principal forest area is the Barca plateau to the east. The annual consumption probably does not exceed 4 cubic feet per capita, or 4,000,000 feet in all. All of it is cut locally.

PORTUGUESE AFRICA

Portuguese colonies in Africa are (a) Portuguese Guinea, (b) Angola (Portuguese Southwest Africa), and (c) Portuguese East Africa (Mozambique). The extent of their forests is shown in Table 369.

Table 369.—Extent of Forests, Portuguese Africa

Colony	Total forest area	Per cent of land area	Area per inhabitant
	acres		*acres*
Portuguese Guinea	900,000	10.1	3.1
Angola (and Kabinda)	10,000,000	3.2	2.4
Portuguese East Africa	18,800,000	6.9	6.0
Total	29,700,000	5.0	3.9

In all of these colonies the consumption of wood is very low, probably not over 5 cubic feet per capita. The total consumption is estimated at 37,640,000 cubic feet, most of it firewood.

Portuguese Guinea

This colony is mostly a delta region, with large swampy areas of mangrove forest and on the higher ground extensive tropical forest, including such species as mahogany, ebony, baobab, kapok, acacia, and various species used locally for boats, buildings, and piles.

The forests are densest along the valleys. Farther back is much

grass and park country. There are large areas of fruit trees—pawpaw, guava, mango, orange, apple-mahogany, lemon, and banana. There are also considerable areas devoted to growing date and oil palms. Shea-butter trees, which yield a vegetable fat, are common.

The principal products are rubber and palm oil.

Angola

In general the country consists of sterile plains covered with grass or thorn scrub. The mountain belt between the coastal plains and the interior plateau has luxuriant vegetation in the northern part, with a considerable area of tropical forest; rubber vines are abundant. The trees include Angola mahogany, coralwood, and other valuable hardwoods. The northern coast district is rich in mangrove and oil palms. Trade is nearly all with Portugal. Timber trade is not important. The principal products of the country are palm oil and kernels and rubber.

Portuguese East Africa

Mangrove forests, valuable for tanbark, abound especially along the northern coast and up the Zambezi River. In the coast region, mangrove timber, which is very durable, is used for building. Stone for building is entirely lacking; the first settlers brought building stone from Europe.

The southern part of the territory has little commercial forest, but is covered largely with thorny scrub, with occasional single trees. Fringe forests occur along the streams. Some of the thorn-veldt (acacias and similar species) is an open, park-like stand of trees a foot in diameter and 30 to 50 feet high, which yield firewood, mine timbers, and railroad ties. Much of this stand has been cut to furnish mine timbers for South Africa.

On the Zambezi River and northward are extensive areas of tropical evergreen hardwood forest. Coralwood (also sold as African padouk) is common, as are also African sandal, African teak, ironwood, mahogany species, and many other valuable woods. Softwoods suitable for building are abundant.

It is stated that there are ample supplies of every kind of wood needed in the province, as well as a large surplus for export. The only reason for importing timber from other countries is that the native timbers do not grow ready cut, seasoned, and planed. Thousands of acres are ready for exploitation.

Except for mine and railway timbers for South Africa little timber is exported. A considerable amount is imported for buildings in the towns. A few companies are cutting native timber.

Important exports are rubber, of which 300 to 400 metric tons (1904-

1907) is exported each year, and vegetable oil. Mangrove bark was exported in considerable quantities (13,000 metric tons in 1907), but exports were forbidden in 1909 in order to let the forest recuperate from excessive cutting.

The chief ports of export are Quelimane, Mozambique, Hajou, and Port Amelia.

Of the several hundred timber trees native to Portuguese East Africa, only a comparatively few are used even locally. The character of the wood of a large number and their suitability for different purposes are very little known. The following are some of the trees which are more commonly used or whose qualities are better known:

TABLE 370.—IMPORTANT TREES, PORTUGUESE EAST AFRICA.

Mnebe or ziba (*Andradia arborea*). One of the most valuable hardwoods, found in considerable quantity in the southern districts.

Chivari (*Baphia ovata*). A valuable hardwood; weight about 63 pounds per cubic foot. Looks like wild olive, and takes a good finish. It is too hard for the natives to cut.

Marriba. A valuable hard wood from a large tree. Wood resembles walnut, but heavier; used for axe handles.

In-saca-saca (*Olea verrucosa*). Hard, dense, heavy, nearly black heartwood. Known as an everlasting timber.

Moanjwa (*Cordyla africana*). Wood heavy, solid, somewhat oily. Weight about 60 pounds per cubic foot. A valuable timber, and the tree grows to a very large size. It is almost the only timber used by the natives in the construction of their native pianos.

Cherole or xirrole (*Randia dumetorum*). Wood dense, nearly like sneezewood, but lighter. Looks like an engraver's wood. Trees never of large size.

Nungwane (*Xanthoxylum capense*). Weight about 55 pounds per cubic foot. Useful for planks, poles, etc., where large enough.

Moatenjetu. Weight about 42 pounds per cubic foot. Valuable for boards or furniture. Trees of small diameter, but of considerable height.

Dane or madane (*Spathodea alba*). Weight about 45 pounds per cubic foot. Valuable for boards. Sometimes a large tree.

Xina, sina, sende, or matende (*Afzelia quanzensis*). Suitable for boards, but sometimes subject to borers. Weight about 40 pounds. A very large tree.

Mo-esu or o-heso (*Albizzia fastigiata*). Very light (about 40 pounds). Used locally as boards for doors; does not warp badly. Throughout the province it is abundant and in suitable sizes.

Cusso (*Trichilia emetica*). Weight 40 pounds. Good wood for boards of considerable width, and obtainable in quantity; not damaged by borers.

Mohoshle (*Bolusanthus speciosus*). Used almost exclusively for spokes; good also for yokes. A white, hard, very durable wood.

Msonga, yellowwood (*Podocarpus elongata*). Useful for planking, quartering, house building, etc., but not obtainable in large quantity.

Fongosi (*Kigelia pinnata*). A light and tough white timber, does not split; good for felloes, naves, yokes, etc.

Umbitzan, umzimbeet, or bekungu (*Weihea subpeltata*). Very heavy, hard, and

TABLE 370.—IMPORTANT TREES, PORTUGUESE EAST AFRICA—*Continued*

durable blackish timber, in long straight logs up to 3 feet in diameter. Used for poles, furniture, etc.

Tomboti (*Excoecaria africana*). Beautiful dark heartwood. Has a strong and permanent smell; is called sandalwood. In Kaffraria and Natal is worn as rough scented beads by the Kafir girls.

Mondo-n-hlovu (*Combretum truncatum*). Very pretty dark wood, almost like ebony. In large trees, 3 feet in diameter, almost all heartwood with narrow yellowish sapwood. Does not rot, and is not damaged by white ants. So cross-grained it cannot split; splendid for mallets; lasts in water and for poles in the ground. Very hard and heavy. Not much used because so difficult to work, as chisels are damaged by one or two strokes at mortising. Formerly burned into form and used for hoes by the natives before iron hoes were introduced. Present in considerable quantity and as large trees from the Limpopo southward.

Mkaia, knopjesdoorn and aapjesdoorn (*Acacia nigrescens*, *A. welwitschii*, and *A. rostrata*). Used largely for mining timber; cut out to a considerable extent along the main line. Durable as fence poles, sills for buildings, etc., but too hard to work, and very trying on tools. Tree occupies large areas as open thorn-veldt.

Mnai, or red ivory (*Rhamnus zeyheri*). Very pretty red timber for furniture.

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SPANISH AFRICA

Spanish Africa includes: (a) a small strip of Morocco, whose forests are insignificant and can probably little more than supply local needs for fuel; (b) Rio de Oro, a practically barren treeless stretch of Sahara on the west coast; (c) Rio Muni or Spanish Guinea. Data regarding the land and forest areas and populations of these colonies are shown in Table 371.

TABLE 371.—THE FOREST SITUATION IN SPANISH AFRICA

Country	Total land area	Population	Forest area		
			Total	Per cent of land area	Per capita
	acres		*acres*		*acres*
Morocco	5,545,600	620,000	[1]	.....	.....
Rio de Oro	69,888,000	495	[1]	.....	.....
Rio Muni	6,060,800	200,000	4,500,000	74.2	22.5
Total	81,494,400	820,495	4,500,000	5.5	5.5

[1] No commercial forest.

Rio Muni or Spanish Guinea

This territory, set into the coast of the French Congo, lies almost entirely within the tropical coast forest belt and is very largely forested. A swampy belt of mangrove extends the whole length of the coast. The forests, which are similar to those of Cameroon and French Congo, have been exploited near the coast and navigable streams for their mahogany.

From Eloby, a little known port situated in the middle of the coast, some Gaboon mahogany (*Aucoumea klaineana*), redwood (*Pterocarpus soyauxii*), and several other timbers have been exported. Despite the fact that the forests, while not extensive, are almost untouched and very rich in mahogany, a comparatively small number of firms have been working them. *Khaya* is less common than elsewhere, while redwood, Gaboon mahogany, light mahogany (*Canarium schweinfurthii*), and bilinga (*Afzelia* sp.) are common woods. There are no forest laws and there is little or no security for any forest rights one may acquire from the natives. This district is supposed to be more unhealthful than others in the region, though probably this is due to local conditions.

The principal mahogany port is Benito.

References

A. Cottes, La Guinée Espagnole, *Ann. de Geogr.*, vol. 18: pp. 433–450, 1909.

CHAPTER VIII

THE FOREST SITUATION IN AUSTRALIA AND OCEANIA

AUSTRALIA

Forest Area.—The total forest area of the Australian Commonwealth is 90,291,500 acres, or 5.8 per cent of the total land area. The forest areas in the different States of the Commonwealth are given in Table 372.

TABLE 372.—DISTRIBUTION OF FORESTS, AUSTRALIA

State	Total forest area	Proportion of the land area	Forest area per head of population	Proportion of the forest area of the Commonwealth
	acres	*per cent*	*acres*	*per cent*
New South Wales	11,000,000	5.6	5.5	12.2
Victoria	8,000,000	14.2	5.6	8.9
Queensland	40,000,000	9.3	57.1	44.3
South Australia and Northern Territory[1]	3,800,000	1.6	8.5	4.2
Western Australia[1]	16,491,500	2.6	49.7	18.2
Tasmania	11,000,000	64.7	52.7	12.2
Commonwealth	90,291,500	5.8	17.6	100.0

[1] Exclusive of some tropical forest in the north.

Character of the Forest.—The forests of Australia are almost wholly mixed hardwoods, belonging chiefly to the eucalyptus and acacia families. The forests of Australia in places rival the forests of the Pacific coast of North America in size and clear length of trees and amount of timber per acre. Karri, for instance, reaches a height of 300 feet with a clear length of 180 feet. The karri of western Australia, the messmate of western Victoria and New South Wales, and the blue gum of Tasmania frequently produce 150,000 to 200,000 board feet per acre and in exceptional instances even as high as 360,000 board feet per acre. There are 60 or 70 species of commercial timber trees, all of which except jarrah and

karri grow in mixed forests. Jarrah and karri are the two chief export timbers. There are several softwoods in Australia: Huon pine in Tasmania, hoop pine, brown pine, Bunya pine, and kauri pine. These pines are found chiefly in New South Wales and Queensland, and are so scattered over inaccessible areas as to render their exploitation slow and costly.

The more conspicuous timber regions of Australia as a whole are the western and southern portions, including Tasmania, and the southwestern portion northward and eastward from Cape Leeuwin. On the eastern side of the continent the largest timber is found on the crests and coastal slopes of the mountain ranges. On the southwest of the continent, in addition to forests between mountains and sea, a large area of forest stretches inland from the coastal ranges. The hills circling Adelaide and Yorke and Eyre Peninsulas bear good forests. The Kimberley district is timbered, and in the Northern Territory and round the shores of the Gulf of Carpentaria there are considerable forest areas. The coastal regions of west and northwest Australia, except the shores of the Great Australian Bight and Encounter Bay, are devoid alike of mountains and forests. The interior is practically destitute of forests except for an occasional limited mountain system covered with trees.

Character of Ownership.—The areas which have been definitely reserved for timber production are shown in Table 373.

TABLE 373.—FOREST OWNERSHIP, AUSTRALIA

State	Total forest area	Possible area of forest reserves dedicated to timber production[3]	Ratio of forest reserves to total forest area
	acres	*acres*	*per cent*
New South Wales	11,000,000	6,000,000	54.5
Victoria	8,000,000	4,000,000	50.0
Queensland	40,000,000	4,000,000	10.0
South Australia	3,800,000	160,000	4.2
Western Australia	16,491,500 [1]	3,000,000	18.2
Tasmania	11,000,000	1,028,000	9.3
Total [2]	90,291,500	18,188,000	20.1

[1] S. W. Division only.

[2] Exclusive of Northern Territory and portion of Western Australia.

[3] The areas of forest reserves are continually changing by addition and elimination; hence the areas given here are too low for several states, including Tasmania, Victoria, and Queensland.

In each of the states areas have been set apart as state forests and timber reserves. In some cases the reservation is made in perpetuity, in others for a definite period, and in still others it may be canceled at any time. Other publicly owned forest is open to alienation without restriction.

Annual Growth.—No official statistics are available for the annual growth in the states of the Australian Commonwealth except Victoria and Queensland. For Victoria the gross annual growth is given as 180 million cubic feet, or 30 cubic feet per acre of commercial forest. Allowing 30,600,000 as loss from fire and waste, there still remains a net annual growth of 149,400,000 or about 25 cubic feet per acre. This is a large annual growth, unless the area upon which it was computed is small and exceptionally productive.

For Queensland the gross annual growth is given as 29 million cubic feet.[1] On the basis of 7 million acres of merchantable forests that would make an annual increment of a little over 4 cubic feet per acre. If calculated on the entire forest area of 40 million acres, the annual growth is less than one cubic foot per acre. Evidently such figures are of no practical value. For purposes of contrasting the annual cut with the annual growth, we may assume an average annual growth of 10 cubic feet per acre. This is a very conservative estimate for eucalyptus forests. On the basis of such an assumption the total net annual growth on the entire forest area, allowing 25 cubic feet for Victoria and calculating the total annual growth of the other states, except Queensland and Western Australia, would be in the neighborhood of 428,048,333 cubic feet, or 4.7 cubic feet per acre. By states the annual growth would be as follows:

	Cu. ft.
New South Wales	110,000,000
Victoria	149,400,000
Queensland	7,333,333
South Australia	38,000,000[2]
Western Australia	13,315,000
Tasmania	110,000,000
Total for the entire Commonwealth	428,048,333
Per acre	4.7
Per capita	83.7

Assuming that only half of this growth will be in the form of sawlog timber, there still is an annual growth, in round figures, of about 215

[1] The net annual growth is given as 7,333,333 cubic feet.

[2] This figure is based on an estimated area of 3,800,000 acres, which is probably much too high. On the basis of about 65,000 acres of productive forest and a growth of even 100 cubic feet per acre, the total would be only 6,500,000 cubic feet.

TABLE 374.—CUT OF SAW TIMBER

State	1913	1914	1915	1916	1917	Average of five years
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
New South Wales	13,741,583	13,741,583[1]	11,745,000[2]	9,600,083[2]	10,436,917	11,853,033
Victoria	6,814,167	7,031,167	5,215,750	5,215,750[1]	5,836,500	6,022,667
Queensland	13,052,833	14,038,000	12,079,167	10,154,167	9,305,250	11,725,883
South Australia	195,167	218,083	195,667	195,667[1]	310,750[2]	223,067
Western Australia	18,242,333	18,941,417	10,291,167	8,363,000	7,101,500	12,587,883
Tasmania	5,065,000	4,348,500	3,990,833	4,334,917	3,748,833	4,297,617
Total	57,111,083	58,318,750	43,517,584	37,863,584	36,746,000[3]	46,711,400

[1]Figures for previous year. [2]Year ended June 30. [3]Including Northern Territory.

million cubic feet or, as will be shown later, far in excess of the average annual cut.

Annual Cut.—The quantity of timber sawn and hewn in each Australian state and in the Commonwealth as a whole is given in Table 374.

The figures show that the cut per acre of hardwoods is not excessive, considering the total forest area. These figures are misleading, however, as only a comparatively small part of the timber is accessible, much of it being on scattered areas at a considerable distance from railroads. Its situation may not justify railroad building for a great many years. The most important areas of accessible workable timber are in Western Australia and are 3,000 miles by water and an average of 100 miles by rail from the Australian centers of timber consumption. The next most important areas are in Tasmania, 400 to 600 miles by water from the markets. The forest areas of importance in Victoria, New South Wales, and Queensland average 100 miles by rail from the nearest markets. As a result the cut falls most heavily on the accessible areas, which are being seriously overcut although the total figures do not show this.

No satisfactory estimates are available for the cut of firewood. Judging by some of the states for which estimates are available, the total cut of firewood in the Commonwealth must be in the neighborhood of 147,504,525 cubic feet, or 28.8 feet per capita. Official statistics of the cut of firewood are given only for Victoria, Queensland, and Western Australia, with partial statistics for South Australia (firewood carried by

TABLE 375.—CUT OF FIREWOOD AND SAW TIMBER, AUSTRALIA

State	Firewood	Total cut of saw timber[1] and firewood
	cu. ft.	*cu. ft.*
New South Wales	50,000,000	61,853,000
Victoria	40,140,000	48,473,300
Queensland	9,000,000	20,726,000
South Australia	11,142,700	11,365,700
Western Australia	32,000,000	45,441,350
Tasmania	5,221,825	9,519,825
Total for Commonwealth	147,504,525	197,379,175
Per acre of merchantable forest	4.7	6.3
Per capita	28.8	38.5

[1]Average of five years, 1913–1917, except that for Western Australia and Victoria the cut of 1919 is given.

rail). Undoubtedly a considerable part of the firewood consists of tops of trees cut for saw timber and is included in the cut of log-sized timber. There is, however, a considerable cut for minor purposes, such as mine props, posts, and so on, which evidently are not included in the sawlog timber, and it may therefore be safe to assume that 25 cubic feet per head of population would not be an excessive estimate of the cut for those states for which no statistics of firewood cut are given. The cut of firewood and saw timber by states is given in Table 375.

Exports and Imports.—The average exports of logs and dressed and undressed lumber, for periods ranging from 5 to 9 years for the different states, amounted to approximately 14,858,000 cubic feet a year. During the same periods timber was imported from various sources to the amount of 31,263,000 cubic feet a year. The excess of imports over exports was therefore 16,405,000 cubic feet. The amount of timber imported for one year (1913) by the several Australian states, and the order of the states according to quantity of importations, is given in Table 376.

TABLE 376.—IMPORTS OF LUMBER, AUSTRALIA

States importing	Chief lumber importing ports	Quantity	Per cent of total
		cu. ft.	
New South Wales	Sydney, Newcastle	15,066,500	43
Victoria	Melbourne	11,087,583	31
South Australia	Adelaide, Pt. Pirie	7,402,750	21
Western Australia	Fremantle, Geraldton	1,225,333	3
Tasmania	Hobart, Launceston	336,583	1
Queensland	Brisbane	168,808	1
Total		35,287,557	100

The imports of lumber into Australia now constitute about 50 per cent of the total consumption of lumber. The increasing dependence of Australia upon outside sources of timber is well shown in the growth of imports for the period between 1903 and 1913 (Table 377).

Table 378 shows the Australian imports for 1913 by classes of timber, and the countries from which Australia imported timber are given in Tables 379 and 380.

The United States is the greatest single exporter of timber to Australia, and New Zealand is next. New Zealand sends softwoods, white and kauri pines, employed extensively in box manufacture, furniture factories, and other wood-using industries. The import of these woods into Australia from New Zealand fell over 35 per cent during the period between 1908 and 1913. New Zealand hardwoods, however, are being exported to Australia in increasing quantities as the softwood forests are depleted. The rapid cutting of New Zealand forests, which are estimated to contain only 30 years' supply, at the present rate of utilization, will probably eliminate that country in the near future as an important timber exporter to Australia. Norway and Sweden come next among

TABLE 377.—GROWTH OF IMPORTS, AUSTRALIA

Class	1903		1913		Increase in values, 1913 over 1903
	Quantity	Value	Quantity	Value	
	cu. ft.		*cu. ft.*		*per cent*
Lumber and logs	14,737,570	$4,345,737	37,255,421	$12,945,052	198
Manufactured goods	.....	206,923	.....	1,097,279	430

TABLE 378.—CLASSIFICATION OF WOOD IMPORTS, AUSTRALIA

Class	Quantity	Value
Rough lumber (M cu. ft.)	28,416	$ 9,384,000
Dressed lumber (M cu. ft.)	6,873	2,942,400
Logs (M cu. ft.)	1,953	580,800
Door stock (M cu. ft.)	419	216,000
Shooks (M bd. ft.)	3,875	194,880
Veneers (M cu. ft.)	163	265,920
Laths (pieces)	46,338,000	192,000
Picture and room mouldings (M bd. ft.)	150	142,500
Staves (pieces)	3,640,000	109,440
Pickets	2,302,000	40,800
Hickory (M cu. ft.)	14	25,440
Shingles (pieces)	1,527,000	10,560
Bent wood	.....	9,600
Doors (pieces)	1,400	2,112
Architraves and mouldings (lin. ft.)	80,000	1,200
Total	.....	$14,117,652

TABLE 379.—ORIGIN OF IMPORTS, AUSTRALIA (1903)

Country	Quantity	Per cent of total	Value	Average value per M ft. b. m.	Average value per 100 cu.ft.
	cu. ft.				
United States	7,396,667	50	$2,040,278	$22.99	$27.58
New Zealand	4,277,084	29	1,157,054	22.54	27.05
Norway	1,817,505	12	745,324	34.17	41.01
Canada	655,906	5	175,905	22.35	26.82
Sweden	466,141	3	172,459	30.83	37.00
Russia	67,533	1	26,827	33.10	39.72
Straits Settlements	21,815	.....	5,779	22.08	26.49
United Kingdom	14,998	.....	9,427	52.38	62.86
Total	14,717,649	100	$4,333,053	$24.53	$29.44

TABLE 380.—ORIGIN OF IMPORTS, AUSTRALIA (1913)

Country	Quantity	Per cent of total	Value	Average value per M ft. b. m.	Average value per 100 cu.ft.
	cu. ft.				
United States	21,518,500	57	$ 6,874,560	$ 26.62	$ 31.95
New Zealand	5,373,917	14	2,078,880	32.24	38.68
Norway	5,202,583	14	2,120,640	33.97	40.76
Sweden	2,456,250	6	1,116,000	37.86	45.44
Japan	1,320,667	4	339,840	21.44	25.73
Canada	1,106,167	3	526,080	39.63	47.56
Russia	928,167	2	334,560	30.04	36.05
India	54,083	.....	85,440	131.65	157.98
Straits Settlements	22,167	.....	6,864	25.80	30.96
Germany	15,333	.....	10,560	57.39	68.87
Netherlands	3,167	.....	7,056	185.68	222.80
United Kingdom	1,250	.....	2,352	156.80	188.16
Total	38,002,251	100	$13,502,832	$ 29.61	$ 35.53

The totals of the imports differ slightly in the three tables showing imports. This is due to the fact that there was a slightly different basis for totaling; in one case it was by states importing; in another case by classes of material; and in still another by countries of origin of import. Evidently not all the same items have been included in totals. They are close enough, however, to give a clear idea of the amount of timber imported by Australia.

the countries shipping timber to Australia. In spite of the fact that the distance from Baltic ports to Australia is 13,000 miles and the distance from western Canadian ports is 7,000 miles, Canada sends only comparatively small quantities of timber. Ten years ago Japan was unknown in the Australian timber trade; now it is supplying more than Canada. Within the period from 1903 to 1913 imports to Australia from the United States increased from 50 to 57 per cent of the total. The imports from New Zealand dropped from 29 to 14 per cent although the quantity increased; those from Norway and Sweden slightly increased in both quantity and proportion of the total, while imports from Canada increased in volume but decreased in relation to the total.

The total export of undressed sawn timber from Australia for the years 1907 to 1918 is given in Table 381.

TABLE 381.—EXPORTS OF SAWN TIMBER

Year	M cu. ft.	Year	M cu. ft.
1907	9,612	1913	11,234
1908	12,163	1914–15[1]	8,865
1909	12,339	1915–16	4,078
1910	11,903	1916–17	2,944
1911	12,210	1917–18	1,626

[1] Fiscal year ending June 30.

TABLE 382.—TANBARK IMPORTED INTO AND EXPORTED FROM AUSTRALIA, 1913 TO 1918.

Classification	1913	1914–15	1915–16	1916–17	1917–18
	cwt.	*cwt.*	*cwt.*	*cwt.*	*cwt.*
Quantities:					
Imports	77,689	66,136	122,188	148,206	71,133
Exports	144,352	77,658	94,468	59,299	97,145
Difference	66,663	11,522	−27,720	−88,907	26,012
Values:					
Imports	$136,017	$121,131	$231,812	$250,100	$120,095
Exports	293,598	155,642	202,822	140,522	222,053
Difference	157,581	34,511	−28,990	−109,578	101,958

NOTE.—The minus sign (−) denotes excess of imports.

TABLE 383.—EXPORTS OF SANDALWOOD, 1913 TO 1918

Country to which exported	Quantity					Value				
	1913	1914–15	1915–16	1916–17	1917–18	1913	1914–15	1915–16	1916–17	1917–18
	cwt.	*cwt.*	*cwt.*	*cwt.*	*cwt.*					
Hongkong	91,054	98,600	96,949	130,314	102,325	$201,573	$234,923	$248,283	$347,296	$369,812
Straits Settlements	17,835	15,985	10,620	10,308	19,576	28,825	47,890	31,153	31,609	59,467
Other British possessions	10,760	11,333	8,576	7,100	2,000	22,162	31,230	22,366	21,525	6,196
China	13,540	50,845	18,850	9,660	14,785	27,182	133,864	45,276	26,992	47,905
Other foreign countries	486	386	120	120	1,842	1,881	1,327	379	496	21,778
Total	133,675	177,149	135,115	157,502	140,528	$281,623	$449,234	$347,457	$427,918	$505,158

The maximum export was evidently reached during the period 1908-1911. The export for the four fiscal years between 1915 and 1918 dropped abnormally, undoubtedly because of war conditions. Whether the export will increase above the pre-war figures remains to be seen.

Besides timber, Australia exports also tanbark, sandalwood, and eucalyptus oil. The extent of the trade in these articles may be judged from Tables 382 and 383.

Large quantities of eucalyptus oil are produced, especially in Victoria. Exports in 1913 were valued at nearly $200,000. Most of it goes to the United States.

Domestic Consumption.—The average annual consumption of timber in Australia, except fuel, posts, piles, and unmanufactured fencing material, was as follows:

	Cu. ft.
Domestic production	49,874,650
Imported lumber and logs	31,263,433
	81,138,083
Less exported lumber and logs	14,858,383
Consumption	66,279,700

The average annual consumption of sawlog timber per head is 13.0 cubic feet. If to this be added the amount of firewood, estimated at 147,504,525 cubic feet, the total consumption will approach 213,784,225 cubic feet, or 41.8 cubic feet per capita.

Forestry Movement.—Each state of the Commonwealth has now organized a separate forest department or branch of service especially charged with forest matters. The revenues and expenditures of state forest departments by fiscal years from 1914 to 1918 are given in Tables 384, 385, and 386.

The figures in Table 386 are all based on the areas of state forests in 1918. As a matter of fact, these areas differed in different years. It would be more nearly accurate if the net revenue from state forests were divided by the exact area during each year to obtain the net revenue per acre. All that the figures show at present is that the net revenue is greatest in Western Australia, while in the rest of the country it is negligible or the administration of the state forests is not on a paying basis.

Several forest schools are now in existence. Forest congresses and interstate conferences on forestry were held in 1911 and 1912, and more recently interstate conferences were held at Adelaide in 1916 and at Perth in 1917 for the discussion of forest matters of general interest to the entire Commonwealth.

TABLE 384.—REVENUES OF STATE FORESTRY DEPARTMENTS, 1914 TO 1918.

State	1913–14	1914–15	1915–16	1916–17	1917–18
New South Wales...	$482,758	$424,696	$331,000	$326,941	$344,909
Victoria.....	280,646	344,253	287,659	245,989	271,757
Queensland.....	306,049	366,045	343,558	295,804	323,968
South Australia.....	33,378	27,158	29,068	49,859	69,396
Western Australia...	234,427	261,973	222,228	92,622	115,989
Tasmania.....	22,643	20,529	17,569	18,760	18,760
Commonwealth.	$1,359,901	$1,444,654	$1,231,082	$1,029,980	[1]$1,144,929

[1]Including Northern Territory, $151.

TABLE 385.—EXPENDITURES OF STATE FORESTRY DEPARTMENTS, 1914 TO 1918

State	1913–14	1914–15	1915–16	1916–17	1917–18
New South Wales...	$217,864	$229,426	$245,581	$358,483	$377,564
Victoria.....	281,914	316,964	316,590	260,258	333,187
Queensland.....	35,896	37,198	36,042	46,248	67,700
South Australia.....	110,964	117,695	120,975	109,695	103,912
Western Australia...	55,710	58,650	43,108	47,662	50,364
Tasmania.....	3,694	5,851	3,319	3,315	5,851
Commonwealth.	$706,042	$765,784	$765,615	$825,661	$938,578

TABLE 386.—NET REVENUES PER ACRE OF STATE FOREST LAND[1]

State	1913–14	1914–15	1915–16	1916–17	1917–18
New South Wales.....	$0.033	$0.024	$0.011	−$0.004	−$0.004
Victoria.....	−0.0002	0.004	−0.004	−0.002	− 0.008
Queensland.....	0.008	0.010	0.009	0.007	0.008
South Australia.....	−0.485	−0.566	−0.574	−0.374	− 0.216
Western Australia.....	0.110	0.125	0.110	0.028	0.040
Tasmania.....	0.018	0.014	0.014	0.015	0.013
Commonwealth.....	$0.012	$0.013	$0.009	$0.004	$0.004

[1] Minus (−) sign indicates deficit.

Probable Future.—The forest situation in Australia is briefly summarized in Table 387.

These figures seem to indicate that, as far as hardwoods are concerned, the cut is below the annual growth and is therefore not fully de-

TABLE 387.—SUMMARY OF FOREST SITUATION, AUSTRALIA

State	Annual growth	Annual cut	Imports	Exports	Consumption	Surplus and deficit[1] (+ or −)
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
New South Wales	110,000,000	61,853,000	12,241,500	1,633,700	72,460,800	+37,539,200
Victoria	149,400,000	48,473,300	10,365,550	74,900	58,763,950	+90,636,050
Queensland	7,333,333	20,726,000	6,000	2,000,000	18,732,000	−11,398,667
South Australia	38,000,000	11,365,700	7,402,750	.....	18,768,450	+19,231,550
Western Australia	13,315,000	45,441,350	911,050	9,098,950	37,253,450	−23,938,450
Tasmania	110,000,000	9,519,825	336,583	2,083,333	7,773,075	+102,226,925
Commonwealth	428,048,333	197,379,175	31,263,433	14,890,883	213,751,725	+214,231,608

[1] Plus means surplus of growth over consumption; minus means deficit of growth.

FORESTS OF AUSTRALIA, NEW ZEALAND
TASMANIA, NEW GUINEA,
HAWAIIAN ISLANDS, ETC.
0 MILES 600
LEGEND
HARDWOODS
CONIFERS
HAWAIIAN ISLANDS
(UNITED STATES)
MILES
0 60
BORNEO
CELEBES
JAVA SEA
BANDA SEA
JAVA
TIMOR I.
ARAFURA SEA
NEW GUINEA
EQUATOR
Friedrich Wilhelmshafen
Port Moresby
SOLOMON ISLANDS
INDIAN OCEAN
GULF OF CARPENTARIA
CORAL SEA
NORTHERN TERRITORY
QUEENSLAND
AUSTRALIA
WESTERN AUSTRALIA
SOUTH AUSTRALIA
NEW SOUTH WALES
VIC.
Amadeus
Lake Eyre
Darling Riv.
Murray Riv.
L. Torrens
Spencer Bay
Adelaide
Geraldton
L. Barlee
L. Moore
L. Lefroy
L. Cowan
Perth
Rockingham
Bunbury
Busselton
Karrida
Port Augusta
Albany
GREAT AUSTRALIAN BIGHT
Rockhampton
Gladstone
TROPIC OF CAPRICORN
PACIFIC OCEAN
Brisbane
Newcastle
Sydney
Melbourne
Beaconsfield
Launceston
TASMANIA
Hobart
TASMAN SEA
NEW HEBRIDES
NEW CALEDONIA
Noumea
FIJI ISLANDS
Suva
Auckland
New Plymouth
Wellington
NEW ZEALAND
Christ Church
Dunedin
Hanalei
KAUAI
NIIHAU
Waialua
Honolulu
OAHU
MOLOKAI
Wailuku
MAUI
Kaunakakai
LANAI
Lahaina
KAHOOLAWE
HAWAII
Kawaihae
Hilo
Kealakekua
110°
120°
130°
140°
150°
160°
170°
180°
10°
20°
30°
40°
50°

PLATE XVI

FORESTS OF AUSTRALIA AND OCEANIA

(*Facing page 908*)

veloped. Since, however, the hardwoods are not as suitable for general building purposes as are the softwoods, and the amount of softwoods was limited to begin with and is almost entirely exhausted, Australia will continue to export its hardwoods for purposes for which they can be used to advantage, such as railroad ties. They will probably be used to an even greater extent for interior finish, flooring, furniture, and manufacture. On the other hand, Australia will continue to import softwoods, particularly Douglas fir, in increasing quantities.

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New South Wales

The total land area of the state of New South Wales is 198,051,200 acres (exclusive of the area set apart as federal territory). The population of the state, according to the figures of 1920, is 2,000,000. The area containing merchantable timber is about 11,000,000 acres, or 5.5 acres per capita. Of this about 8,000,000 acres is still the property of the state and about 3,000,000 acres either has been alienated or is in process of alienation. About 5.6 per cent of the land area is covered by forest.

Character of Forest.—Three main types of forest are distinguished:

1. Hardwood, of which eucalypts and allied genera are the principal timber trees.
2. Cypress (*Callitris*).
3. Brush or jungle.

1. *Hardwood.*—The hardwood forests may be divided into sub-types according to the amounts of rainfall and the species of eucalypts which predominate.

2. *Cypress.*—The cypress forests are composed chiefly of *Callitris robusta* and *Callitris calcarata,* the former being by far the more valuable and abundant.

3. *Brush or jungle.*—The brush forests are or were restricted practically to the warm climate of the north and south coasts. They are composed of a number of species, among which the most valuable are *Cedrela australis, Gmelina leichardtii, Araucaria cunninghamii, Flindersia australis, F. oxleyana,* and *Grevillea robusta.* The most abundant of these species is the conifer *Araucaria,* but none of them remains in sufficient quantity to have an appreciable and lasting influence on the timber supply of the state. Other species which, owing to the shortage of imported softwoods, are now finding a market, are *Ceratopetalum apetalum, Sloanea woollsii, Cryptocarya* species, *Litsea* species, *Elaeocarpus* species, *Tarrietia argyrodendron, Fagus moorei, Doryphora sassafras, Dysoxylum* species, *Geissois benthami,* and *Schizomeria ovata.*

From a commercial standpoint the forests of New South Wales may be divided into five belts:

1. Coastal
2. Brush
3. Highland
4. Interior
5. Western

These belts extend from the coast into the interior.

Coastal.—This belt runs the entire length of the state close to the shore of the South Pacific Ocean. It embraces a land area of about 13,797,000 acres, of which forest occupies about 4,900,000 acres. The timber is mainly hardwood of good quality, is ample for the needs of settlement, and even provides a margin for export.

Brush.—This belt adjoins the coastal belt and extends for about half the length of the state from the north southward. The land area is 6,339,000 acres, of which the forest covers about 1,500,000 acres. The timber is mainly softwood of good quality and ample for the needs of settlement. The most abundant of the conifers is *Araucaria.*

Highland.—This belt is confined to the higher mountains. The land area is about 30,039,000 acres, and the forest area about 1,700,000 acres. The timber supply is generally scattered and sparse, consisting mainly of hardwoods of fair quality and suitable for the needs of a pastoral, agricultural, and mining population.

Interior.—West of the highland belt is the interior belt, with a land area of 81,008,000 acres. The forest occupies an area of about 2,900,000 acres. The timber supply is generally scattered and sparse, including both hardwoods and softwoods of fair quality.

Western.—This is the farthest interior belt which contains any forest. Its area is about 66,868,000 acres. The forest area is comparatively small. It is a region of light rainfall, occupied largely by a grazing and mining population. The timber supply is very sparse and scattered, of inferior quality, and not enough for the needs of the local population.

A list of the principal trees, with their general distribution and important uses, is given in Table 388.

TABLE 388.—PRINCIPAL TREES, NEW SOUTH WALES

Hardwoods

Common name	Botanical name	Principal locality and supply	Principal uses
White or grey ironbark	*Eucalyptus paniculata*	Coast zone; not plentiful	Girders, ties, piles, naves, felloes, sawn and hewn bridge timber, etc.; any situation where special strength is required.
Red ironbark	*E. siderophloia*	Coast zone; not plentiful.	
	E. crebra, *E. sideroxylon*	Coast and interior zones; fairly plentiful	
White stringybark	*E. eugenioides*	Coast and highland zones; not plentiful	Buildings, ties, fence posts and poles.
Red stringybark	*E. capitellata*, *E. macrorhyncha*	Highland zone; fairly plentiful	
Mountain ash	*E. gigantea*	Highland zone; fairly dense over 50,000 acres	Buildings, vehicle framing, oars, implement handles, tool handles.
Coast ash	*E. sieberiana*	Coast zone; fairly plentiful in south.	

TABLE 388.—PRINCIPAL TREES, NEW SOUTH WALES—*Continued*

Hardwoods

Common name	Botanical name	Principal locality and supply	Principal uses
Blackbutt	*E. pilularis*	Coast zone; plentiful	House and ship-building, wood paving, wagon scantling, ties, posts, poles.
Tallow-wood	*E. microcorys.*	Coast zone; fairly plentiful.	Flooring, decking, building, framing, girders, ties.
White mahogany.	*E. acmenioides*	Coast zone; fairly plentiful.	Buildings, posts, piles, ties, girders.
Spotted gum	*E. maculata*	Coast zone; fairly plentiful.	House building, coach building, wheelwrighting, framing, ship planking, implement handles.
Grey box	*E. hemiphloia*	Coast and highland zones; not plentiful.	Sawn bridge timber, framing, ties, girders, posts, naves, cogs, mauls.
Red mahogany	*E. resinifera*	Coast zone; not plentiful.	Weather-boarding, wood paving, turnery, heavy furniture.
Grey gum	*E. punctata* *E. propinqua*	Coast zone; plentiful	Short girders, ties, posts, poles, and groundwork generally.
Murray red gum	*E. rostrata*	Interior zone; fairly plentiful.	Building and bridge timber, girders, ties, paving blocks, posts, piles.
Forest red gum	*E. tereticornis*	Coast and highland zones; not plentiful.	Building timber, naves, felloes, posts, poles.
Sydney blue gum or brush gum.	*E. saligna*	Coast zone; plentiful	General building, shipwrights' and wheelwrights' work, wood paving, wheel felloes.
Woolly butt	*E. longifolia*	Coast zone; not plentiful.	Building, posts, poles, ties.
Blood-wood	*E. corymbosa*	Coast zone; plentiful	Posts, poles, and ground work generally.
Red box	*E. polyanthemos.*	Coast and highland zones; not plentiful.	Rough building, posts, poles, slabs, and ground work generally.
Turpentine	*Syncarpia laurifolia.*	Coast zone; plentiful	Piles, posts, ties, fencing.
Brush box	*Tristania conferta.*	Coast zone; plentiful	Bridge decking, paving, mallets, chisel handles.
Red cedar	*Cedrela australis.*	Coast and brush zones; very scarce.	Furniture, house joinery, cabinet ware.
Rosewood	*Dysoxylum fraseranum.*	Coast and brush zones; not plentiful.	Furniture, cabinet-ware, paneling, turnery, wood carving, engraving.
Red bean	*Dysoxylum muelleri.*	Brush zone; not plentiful.	Building, furniture, cabinet and fancy work.

TABLE 388.—PRINCIPAL TREES, NEW SOUTH WALES—*Continued*

Hardwoods

Common name	Botanical name	Principal locality and supply	Principal uses
White beech	*Gmelina leichardtii.*	Coast and brush zones; not plentiful.	Flooring, ship decking, house fitting, picture framing, wood carving.
Brown beech or bally gum.	*Litsea reticulata.*	Coast and brush zones; scattered.	Lining boxes, casks, wood carving.
Silky oak	*Grevillea robusta.* *Orites excelsa.*	Coast and brush zones; not plentiful.	Casks, staves, kegs, furniture, paneling, picture framing.
Red silky oak	*Stenocarpus salignus.*	Coast and brush zones; not plentiful.	Furniture, veneers, staves, gun stocks, walking sticks, picture frames.
Black bean	*Castanospermum australe*	Coast and brush zones; not plentiful.	Cabinet work, staves, furniture.
Coachwood	*Ceratopetalum apetalum.*	Coast and brush zones; plentiful.	Coachbuilding, boatbuilding, carpentry, joinery, cabinets, box-wood.
Cudjerie	*Flindersia schottiana.*	Brush zone; scarce	Furniture, flooring. general building, handles.
Native teak	*Flindersia australis.*	Brush zone; not plentiful.	House building, flooring, slabbing, gearing wheels.

Coniferous Woods

Hoop (colonial) pine.	*Araucaria cunninghamii.*	Coast and brush zones; fairly plentiful as a brush species.	Floorings, linings, ceilings, shelving, butter boxes, packing cases.
Cypress pine	*Callitris* species.	Interior zone; small trees fairly plentiful, mature trees scarce.	Buildings, ceilings, linings, flooring, house blocks, ground posts, poles.

Character of Ownership.—The character of ownership is shown in Table 389.

TABLE 389.—CLASSIFICATION OF OWNERSHIP, NEW SOUTH WALES

Owned by	Area	
	acres	*per cent*
State		
Dedicated to timber production	5,043,840	45.8
Other forest	2,956,150	26.9
Total	8,000,000	72.7
Private individuals and corporations.	3,000,000	27.3
Total	11,000,000	100.0

Of the 8,000,000 acres still in the possession of the crown, 5,044,000 acres has been set apart as state forests and 1,847,000 acres reserved temporarily, a total of 6,891,000 acres. The policy of the state is to create ultimately permanent state forests of not less than 5,500,000 acres, with the possibility of adding later 2,500,000 acres of other forest land, making 8,000,000 acres of permanent state forests. There is no municipal ownership of forests, and except for a limited area of forested land in the possession of coal and other mining companies, there is no corporate ownership of forests.

Annual Growth.—No statistics are available as to the annual growth in the New South Wales forests. Assuming 10 cubic feet per acre, the net increment may be taken as 110,000,000 cubic feet.

Annual Cut.—The total cut of New South Wales averaged for the five years 1913–17, 11,853,000 cubic feet, or 1.1 cubic feet per acre and 5.9 cubic feet per head of population. This evidently does not take into account the amount of wood cut for fuel. Assuming that the cut of wood for fuel in New South Wales is about 25 cubic feet per capita, the total cut of all material must be approximately 61,853,000 cubic feet.

Exports and Imports.—The average annual exports and imports of timber for the period of nine fiscal years from 1911 to 1919, inclusive, is given in Table 390.

Table 390.—Exports and Imports of Timber, New South Wales

Exports		Imports		Excess of imports	
Quantity	Value f. o. b.	Quantity	Value c. i. f.	Quantity	Value
cu. ft. 1,633,700	$977,346	*cu. ft.* 12,241,500	$5,085,504	*cu. ft.* 10,607,800	$4,108,158

The imports consist almost exclusively of softwoods, the exports of hardwoods. The principal countries to which timber was exported for the nine years 1911 to 1919 are given in Table 391.

Domestic Consumption.—With an annual cut of saw timber of 11,853,000 cubic feet and of firewood 50,000,000 cubic feet, and an excess of imports over exports of 10,607,800 cubic feet, the total consumption must be 72,460,800 cubic feet. This represents a total per capita consumption of 36.2 cubic feet, and of saw timber alone of 11.2 cubic feet.

TABLE 391.—DESTINATION OF EXPORTS, NEW SOUTH WALES

New Zealand		United Kingdom		America and Canada		Other places, principally Pacific Islands and the East	
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
cu. ft. 804,600	$454,410	*cu. ft.* 111,230	$72,220	*cu. ft.* 133,740	$122,958	*cu. ft.* 584,170	$327,904

The Forestry Movement.—New South Wales has a commission in charge of forest matters in the state. This commission consists of three members and has its headquarters at Sydney. Its policy is gradually to change timber operations, carried on until recently under license more or less controlled, to government cutting of timber and its disposal either at the stump or in timber yards. Fire protection is being extended to all the forests. Where complete fire protection is impossible under existing conditions, however, as in eucalyptus forests, light burning in the safe season is practiced as a precautionary measure against large conflagrations. Although the main efforts are directed toward control and management of natural forests, afforestation receives considerable attention. The plans are to plant coniferous species, chiefly in the highland belt, on areas which are not capable of producing valuable forests of local species. The planting proceeds at the rate of about 1,000 acres a year, and the area mapped out for planting is 60,000 acres. No assistance is given to private forest owners. No free nursery stock is provided, and there are no grants or remission of taxation. These are not necessary, as private forestry is practically non-existent. The state provides nursery stock and advice free of charge to municipalities and other public bodies for planting on streets, roads, parks, and other public lands, more for ornamental than for economic purposes. The Forest Commission was created under the Forestry Act of 1916. During the two years 1918-19 the income and expenditures were as follows:

Fiscal year	Income	Expenditure	Deficit per acre
1917–18.....	$344,909	$377,564	$0.004
1918–19.....	474,302	588,847	0.014

A school for training technical foresters and the subordinate staff was opened in March, 1920, at Gosford, about 50 miles north of Sydney. Considerable research is now being conducted on pulping qualities of woods; chemical properties of resin; fiber values of plants; physical properties of timbers; fodder values of trees and shrubs; essential oil values of foliage; products of the dry distillation of woods; values of wood ash; qualities of wood tar; and possible uses to which native woods may be put. In addition, studies of the rates of growth and methods of reproduction of native species, and experiments in thinning and coppicing, and the seasoning of wood are being conducted.

The Probable Future.—The forest situation in New South Wales is summarized in Table 392.

TABLE 392.—SUMMARY OF FOREST SITUATION, NEW SOUTH WALES

Kind of product	Annual cut	Exports	Home consumption of home-grown timber	Imports	Total home consumption of home-grown and imported timber	Net increment	Excess increment
Timber and firewood.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Total	61,853,000	1,633,700	60,219,300	12,241,500	72,460,800	110,000,000	37,539,200
Per capita	30.9	0.8	30.1	6.1	36.2	55.00	18.8

At the present rate of cutting, hoop pine (*Araucaria*) will be practically exhausted in 12 years. The supply of cypress can be maintained by building railroads in the forests yet untouched. The present rate of cutting of hardwoods can be maintained indefinitely under forest management.

Queensland

Total Forest Area.—The State of Queensland comprises 429,120,000 acres (670,500 square miles). Of this, 40,000,000 acres (62,500 square miles), or 9.3 per cent of the entire land area, is classed as forest. The population is 700,000, and the per capita forest area is 57.1 acres. Table 393 gives the total area of forest and the percentage of the land area covered by agricultural crops, forest, and other land.

Character of the Forest.—The forests are divided into (1) softwood forests and (2) hardwood forests, determined largely by moisture conditions.

1. *Softwood Forests.*—This type, commonly known as "scrub," occurs in the rainfall belt fringing the long stretch of the coast where precipitation is from 30 to 100 inches. It is confined chiefly to the alluvial bot-

toms and the rich volcanic highlands and is of patchy distribution. The principal timbers of Queensland come from this type. Several subtypes may be distinguished.

The Araucaria sub-type.—This occurs largely in the southwestern corner of the state but rarely extends north of Gladstone. The dominant species are "hoop pine" (*Araucaria cunninghamii*) and Bunya pine (*Araucaria bidwillii*). There is probably over 1 million acres of this type in the state, comprising a stand between 83,000,000 and 167,000,000 cubic feet in the log. The pine is associated with yellowwood (*Flindersia oxleyana*), Queensland teak (*Flindersia australis*), white ash (*Flindersia schottiana*), bally gum (*Litsea reticulata*), and pink poplar (*Euroschinus falcatus*).

The jungle sub-type.—With increase in moisture the Araucaria subtype is displaced by more moisture-loving species, among which the *Meliaceae* and *Laurineae* are largely represented.

2. *Hardwood Forests.*—These forests consist preponderantly of eucalypts, with some admixture of other species of *Myrtaceae* and *Leguminosae.*

The important timber trees of Queensland are given in Table 394.

Character of Ownership.—The state owns 85 per cent of the entire forest area and corporate bodies and private individuals the remaining 15 per cent. The forests owned by corporate bodies and private individuals are being cleared for settlement. They will not, therefore, be devoted to timber production. They supply at present 74 per cent of the total timber cut in the state. The forest area is classified by ownership as given in Table 395.

TABLE 393.—FOREST AREA, QUEENSLAND

	Agricultural land	Forest			Other land	Total
		Merchantable	Unprofitable or inaccessible	Total		
Acres [1]	9,600,000	7,040,000	32,960,000	40,000,000	379,520,000	429,120,000
Percentage of total area	2.2	1.6	7.7	9.3	88.5	100

[1] Approximately only—no satisfactory survey has been made; only 800,000 acres are under crops in Queensland, or 0.19 per cent of the total area.

TABLE 394.— IMPORTANT TREES, QUEENSLAND

Common name	Botanical name	Quality of wood	Uses
Hoop pine	*Araucaria cunninghamii*	Weight 30–37½ lbs. per cu. ft.; modulus of rupture 14,700–9,750; crushing 8,450–6,750	Used for all inside purposes. Excellent for joinery, cabinet purposes, staves and butter boxes. Also used in making railroad cars
Bunya pine	*Araucaria bidwillii*	Weight 31.5–33.7; modulus of rupture 14,150 –13,700; crushing 8,120 –7,530	Used for staves and motor boats
Kauri pine	*Agathis palmerstoni*	Liable to attack by borers if left lying in the scrub.	Cabinet work, paneling, framing, and for building light boats
Cypress pines	*Callitris* spp.	Most durable softwood in the world; also white-ant resistant. Weight 50.5; modulus of rupture 5,120 – 4,920; crushing 6,130 – 4,450	Principal timber used in the south-western districts
Grey iron bark and narrow-leaved iron-bark	*Eucalyptus paniculata* and *Eucalyptus crebra*	Very durable. Weight 68 to 75; modulus of rupture 20,500–14,000; crushing 12,200–9,400	General building purposes, especially railroad building, where great strength is required, such as for girders, headstocks, bridge building, underframes for wagons and carriages, spokes and shafts of heavy vehicles; piles and ties
Spotted gum	*Eucalyptus maculata*	Weight 65.7–76.1; modulus of rupture 20,500–13,600; crushing 11,250 –9,000	Used for same purposes as grey ironbark, except in contact with the ground. On account of greasy nature of timber, it is particularly favored for skidding; used also for railroad ties
Tallow-wood	*Eucalyptus microcorys*	Very durable and excellent quality timber. Weight 58–75; modulus of rupture 18,200–9,900; crushing 10,500–6,800	Suitable for all purposes exposed to weather and is especially desired for railway ties, veranda posts, and flooring
Blackbutt	*Eucalyptus pilularis*	Weight 56–71; modulus of rupture 16,200–12,000; crushing 10,450–6,300. Very durable	Extremely useful for building and car sheathing. Being straight in the grain, much used for splitting into rails and palings; excellent for ties
Grey gum	*Eucalyptus propinqua*	Very durable. Weight 70.1–74.4; modulus of rupture 19,700–14,600; crushing 11,000–6,800	General building purposes and railway ties
Red stringy-bark	*Eucalyptus resinifera*	Subject to pin-hole borers. Weight 63.4–72.2; modulus of rupture 20,300–13,800; crushing 10,-600–8,200	House building, particularly for weather boards; used also for car sheathing

TABLE 394.—IMPORTANT TREES, QUEENSLAND—*Continued*

Common name	Botanical name	Quality of wood	Uses
Yellow stringy-bark	*Eucalyptus acmenioides*	Weight 63.4–71.8; modulus of rupture 14,000–9,000; crushing 8,850–7,400	General purposes
Red blood-wood	*Eucalyptus corymbosa*	Weight 55.3–73.3; modulus of rupture 23,200–9,700; crushing 12,300–7,100. Particularly subject to gum-streaks.	Excellent for fencing, foundations, and ties
Turpentine	*Syncarpia laurifolia*	Durable, light, and easy to work. Weight 63.4–68; modulus of rupture 15,600–8,600; crushing 9,990–7,480. Very fire-resistant	Suitable for decking of wharves; and for large beams; used for ties and for fender piles of wharves; in railway shops used for car sheathing and posts
Scrub box	*Tristania conferta*	Durable, but has tendency to warp in small sizes	Used largely in New South Wales.
Red cedar	*Cedrela australis*	Wood light, soft, easily worked, aromatic, and very durable when exposed to weather. Weight 33.5; modulus of rupture 11,500; crushing 6,600	Most valuable for cabinet and decorative purposes. Used largely for construction of racing boats
Crow's ash	*Flindersia australis*	Wood hard, oily, and very durable. Weight 58.3–61.7; modulus of rupture 12,300 – 15,800; crushing 6,800–7,600	Used chiefly for flooring ballrooms, skating rinks, verandas, railroad cars. Suitable for staves, tool handles and bearings
Red beech or maple	*Flindersia chatawaiana*	Timber slightly aromatic; fair bending timber	General building purposes; most valuable cabinet wood in South Queensland; suitable for rifle stocks, airplane propellers, boat building, railroad car construction, frame work, mouldings, panels and general furnishings
Rosewood	*Dysoxylum fraseranum*	Wood red, fragrant and very durable	Cabinet purposes
Bull oak, brown oak, silky oak	*Cardwellia sublimis*	Good bending timber. Air-dry weight about 38	Used largely for cabinet work, staves, and general building purposes, seats of vehicles, railroad cars, mouldings, framework,and paneling

TABLE 394.—IMPORTANT TREES, QUEENSLAND—*Continued*

Common name	Botanical name	Quality of wood	Uses
Bally gum (*Lauraceae*)	*Litsea reticulata* and *L. ferruginea*	Wood light, very soft. Weight 35.5; modulus of rupture 11,150–9,850; crushing 6,100–5,200. Easy to work and carve	Used for all inside work, staves, and boat building. Excellent cabinet wood.
Northern bally gum (*Sapindaceae*)	*Blepharocarya involucrigera*	Light, soft, pink, rather woolly timber. Weight about 46	Suitable for inside work. Used largely for staves on account of cheapness
Black walnut (*Laurineae*)	*Cryptocarya palmerstoni*	Rich brown, moderately hard, heavy, and very beautiful wood. Turns and polishes well. Weight about 49	
Crow's foot elm (*Sterculiaceae*)	*Tarrietia argyrodendron*	Brown, straight-grained, and beautifully marked wood when cut on the quarter. Not durable when exposed to weather. Hard when dry; tough and elastic when green. Weight 61.2–62.4; modulus of rupture 14,000–16,800; crushing 18,900–10,500	Cabinet work, paneling, railroad cars, tool handles
Black bean (*Leguminosae*)	*Castanospermum australe*	Wood rich dark brown with light streaks, moderately hard, heavy, and very durable. Weight about 46	Excellent cabinet wood; used also for framing, moulding, and paneling

TABLE 395.—OWNERSHIP OF FORESTS, QUEENSLAND

Owned by	Area	
	acres	*per cent*
State		
Dedicated to timber production	4,000,000	10
Other forests	30,000,000	75
Total	34,000,000	85
Corporate bodies and private individuals	6,000,000	15
Total	40,000,000	100

Annual Growth.—The total annual growth is estimated at 29,333,333 cubic feet (352 million superficial feet). The loss from fire is given as 7,333,333 cubic feet (88 million superficial feet) and loss from waste and decay 14,666,667 cubic feet (176 million superficial feet), or a total loss of 22,000,000 cubic feet (264 million superficial feet). This leaves a net growth of 7,333,333 cubic feet (88 million superficial feet). The net growth per acre is thus 0.2 cubic foot for the entire forest area of 40 million acres, or 1 cubic foot per acre of merchantable forest area.

Annual Cut.—The average annual cut amounts to 11,726,000 cubic feet of saw timber and 245,000 tons of fuelwood (about 9,000,000 cubic feet). (1 ton=about 36.7 cubic feet.) Of the saw timber 74 per cent comes from private forests and the balance from state forests. Of the total amount of firewood cut, 200,000 tons, or 82 per cent, comes from private forests and 45,000 tons, or 18 per cent, from state forests. The average cut per acre of forest is 1.7 cubic feet of saw timber and 1.3 cubic feet of firewood, or a total of both kinds of 3.0 cubic feet.

Exports and Imports.—Queensland exports on an average 2,000,000 cubic feet of softwoods valued at $2,430,000 (f.o.b.) and imports 6,000 cubic feet of American hickory valued at $7,290 (c.i.f.). The exports are thus 1,994,000 cubic feet in excess of the imports. Most of the exports go to the other Australian states. There is no interstate timber imported. Whatever is imported comes from overseas.

Domestic Consumption.—The total domestic consumption of home and imported timber is 18,732,000 cubic feet, or 26.8 cubic feet per head of population.

The Lumber Industry and Other Wood-Using Industries.—In 1918 the lumber industry sawed 15 million cubic feet of timber. Of this, 9 million cubic feet was pine, 30,000 cubic feet cedar, and the rest hardwoods. The value of this cut was $6,512,400 and it gave employment to 3,500 people. About 1,500 to 2,000 other persons were engaged in getting out logs, railway and mine timber, and poles. A large number of others were engaged in getting out fuel and cutting fence posts, and about 100 people in the harvesting of sandalwood and mangrove bark. A pulp mill was erected at Yarraman for making paper pulp from the pine tops. These operations ceased in 1919, however, mainly because of water difficulties.

The Forestry Movement.—The Forest Service of Queensland is at present merely a branch of the Department of Public Lands. It is responsible to the Minister for the management and control of permanent reservations. The Lands Department has charge of the leasing of the timber reserves and of the reservation of crown lands for forestry. In other words, the situation is similar to that which existed in the early 90's in the United States. The Forest Service has direct charge of forest

fires which occur on the forest reserves. Fire protection clauses are inserted in timber-sale agreements and licenses wherever necessary. A new act provides larger power for the Forest Service in dealing with the fire question. The Forest Service is engaged in actual timber harvesting and marketing. During 1919 it logged and sold some 667,000 cubic feet of timber, aside from sales on the stump, which brought up the total annual cut on crown forests to about 5,000,000 cubic feet, log measurement. The Service maintains nurseries and plantations, and is planning a school of forestry and an institution of silvicultural research at Imbil, Mary Valley Line, Queensland.

The growth of the revenue and expenditures during the past 15 years may be seen from Table 396.

TABLE 396.—FOREST REVENUE, QUEENSLAND

Year	Expenditure	Revenue	Net revenue per acre
1904	$4,068	$55,603	0.002
1905	3,460	56,264	0.002
1906	6,469	70,762	0.002
1907	7,528	108,067	0.003
1908	10,362	135,978	0.004
1909	11,897	171,072	0.005
1910	12,383	192,675	0.005
1911	14,240	261,662	0.007
1912	26,229	308,352	0.008
1913	35,896	306,049	0.008
1914	37,198	366,045	0.010
1915	36,042	343,558	0.009
1916	46,248	295,804	0.007
1917	67,700	323,968	0.008
1918	106,322	347,398	0.007
Total	$426,042	$3,343,257	.....
Average	28,403	222,884	0.006

Probable Future.—The forest situation in Queensland is summarized in Table 397.

Queensland at present is overcutting its forest at the rate of about 11,399,000 cubic feet a year. This is due to the fact that most of the cutting is taking place on private lands which are cleared for settlement with no thought of forest production. As the private timber is cut the cuttings will be confined more and more to crown lands. As the bulk of the forests are in state control and under management, their productivity will be increased by reducing waste, decay, and fire. The immediate

prospects, however, are that the timber resources are barely sufficient to meet requirements at the present rate of cutting, much less the increasing demand for the future.

TABLE 397.—SUMMARY, FOREST SITUATION, QUEENSLAND

Timber and Firewood	Cut	Exports	Domestic consumption of home-grown timber	Imports	Total domestic consumption of home-grown and imported timber	Net increment	Excess of consumption over increment
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Total.....	20,726,000	2,000,000	18,726,000	6,000	18,732,000	7,333,000	11,399,000
Per capita....	29.61	2.86	26.75	0.01	26.76	10.48	16.28

South Australia

Forest Area.—The total land area of South Australia is 243,244,800 acres. Forest occupies about 3,800,000 acres, or 1.6 per cent. With a population of 445,708, this represents a per capita forest area of 8.5 acres. This, however, is misleading, as most of it is probably covered with brush rather than with true forest. The only definite figures concern the 160,000 acres of state forest, which is believed to include most of the timber. Of this, 15,883 acres is plantations, 94,434 acres is lightly wooded with scrubby unprofitable growth of value only for grazing and protection from erosion, and 49,674 acres is fairly well timbered, carrying 100 cubic feet and upward per acre. The total productive forest area may thus be placed at 65,557 acres, or 0.1 of an acre per inhabitant.

Character of the Forest.—The most extensive area occurs in the Mount Lofty ranges, situated near the Gulf of St. Vincent, at altitudes of 1,000 to 2,000 feet. Stringybark (*Eucalyptus obliqua*), red gum (*E. rostrata*), blue gum (*E. leucoxylon*), and pink gum (*E. fasciculosa*) are found here. Another area of fair forest occurs in the Flinders ranges, at altitudes of 1,000 to 3,000 feet. The prevailing trees are box gum (*Eucalyptus hemiphloia*), blue gum (*Eucalyptus leucoxylon*), red gum (*Eucalyptus rostrata*), and sugar gum (*Eucalyptus corynocalyx*). The well-known Wirrabara forest is situated in the Flinders ranges.

The dominating trees of South Australia are eucalypts. The principal species are:

Red gum (*Eucalyptus rostrata*)
Blue gum (*Eucalyptus leucoxylon*
Pink gum (*Eucalyptus fasciculosa*)
Sugar gum (*Eucalyptus corynocalyx*)
Box gum (*Eucalyptus hemiphloia*)
Stringybark gum (*Eucalyptus obliqua* and *E. capitellata*)
Manna gum (*Eucalyptus viminalis*)

Another species of the same order (*Myrtaceae*) as *Eucalyptus,* which occurs frequently as an understory and at other times mixed with she oak, is the ti tree (*Melaleuca curvifolia*). Other timber trees characteristic of South Australia are she oak (*Casuarina quadrivalvis*), bull oak (*C. lehmanniana*), *scrub oak* (*C. lepidophloia*), and black oak (*C. glauca*), all belonging to the order *Casuarineae.* There are also a number of wattles, or *Acaciae,* such as golden wattle (*Acacia pycnantha*), black wattle (*A. decurrens*), silver wattle (*A. retinodes*), and blackwood (*A. melanoxylon*), of the order *Leguminosae.* There are several native pines (*Callitris robusta* and *Callitris propinqua*).

Character of Ownership.—The state owns the entire known forest area, namely, 160,000 acres. There are no areas under the control of municipal or other corporate bodies. There must be some timber owned privately, especially in the Mt. Lofty ranges, but no data are available.

Annual Cut.—The average annual cut for the five years 1913-1917 was 2,676,800 superficial feet, or 223,000 cubic feet. This does not include the amount cut for firewood, which must be in the neighborhood of 11,142,700 cubic feet. The cut of saw timber per acre of merchantable forest is thus 3.4 cubic feet. In 1913 there were 24 mills.

Exports and Imports.—South Australia exports practically no timber, but imports hardwoods from Western Australia and Tasmania, and softwoods from America and Europe. In 1913, 7,402,750 cubic feet of softwoods, or 21 per cent of the total imports to the Australian Commonwealth for that year, were imported.

Domestic Consumption.—With a domestic cut of 223,000 cubic feet (2,676,800 superficial feet) and an import of 7,402,750 cubic feet, the total consumption of sawlog material in 1913 was 7,625,750 cubic feet (91,509,800 superficial feet), or 17.1 cubic feet per head of population. Allowing for 11,142,700 cubic feet of fuelwood, the total per capita consumption of South Australia may be placed at 42.1 cubic feet.

Annual Growth.—There are no figures to show the annual growth in the forests of South Australia or the extent to which the quantity of timber annually used exceeds the annual increment. It is safe to say that the cut far exceeds the amount produced in merchantable forest. If there really is 3,800,000 acres of forest, the total growth may be 38,000,000 cubic feet.

Forestry Movement.—South Australia has a forest law, passed in 1882, which provides that the control of forests shall be vested in the Commissioner of Forests, with ample powers to deal with all circumstances which may arise. The State Forest Department conducts its own logging, maintains a very efficient system of fire protection, and plants waste and poorly timbered areas. Recently 19.2 acres of pine plantations have been sold, which, at a rotation of 37 years, yielded an

average annual increment of 222 cubic feet per acre. A forestry course has been given at Adelaide University for some years. The lecturer in forestry also conducts forest investigations.

Probable Future.—On the whole, South Australia possesses but limited opportunities for developing forests by natural regeneration. During the last 40 years, however, the state has had a progressive and constructive forest policy regarding planting, and her pine plantations are probably the best in the entire Australian Commonwealth. Importations of hardwoods will probably continue. It is anticipated, however, that the pine plantations now established, with those that are being created under a vigorous forest policy, will ultimately overtake the demand for softwoods and prove equal to the state's requirements.

Tasmania

Forest Area.—Tasmania is an island with a total land area of 17 million acres. Of this 11 million acres is classed as forest. This, however, does not represent the present commercial forests of Tasmania. If every acre bearing trees of any sort should be counted, there may be 11 million acres of forest. The marketable timber, however, occurs only in belts and patches. At an estimate of 11 million acres the forest occupies 64.7 per cent of the total land area. With a population of 208,873 in 1918, this represents 52.7 acres per head of population. The extent of the commercial forest is probably about 4 million acres.

Character of Forest.—The principal timber wealth of Tasmania is hardwoods, chiefly eucalypts. The two most numerous and important species of eucalypts are blue gum (*Eucalyptus globulus*) and stringybark gum (*E. obliqua*). They form the chief product of the Tasmanian forests. The other eucalypts are swamp gum (*E. regnans*), peppermint gum (*E. amygdalina*), gum-top stringybark (*E. haemastoma*), and white gum (*E. viminalis*). Of the other species may be mentioned:

Huon pine (*Dacrydium franklinii*). This species is confined exclusively to the west coast. A better wood for boat-building does not exist.

Blackwood (*Acacia melanoxylon*). This species is found in most parts of the island. The best comes from the south, east, and northeast, although the largest supplies are from the northwest. It is one of the best furniture woods that Australia produces.

Myrtle or beech (*Fagus cunninghami*). Although a true beech botanically, the wood is very unlike the common beech. It has more the appearance of birch. The wood is tough and strong, but opinions differ as to its durability when exposed to alternate wet and dry conditions.

Character of Ownership.—An area of 1,672,000 acres is especially reserved as state forest, although some of the land may be thrown open for settlement.

Annual Growth.—Assuming a growth of 10 cubic feet per acre on the entire forest area, the annual net increment would be 110,000,000 cubic feet.

Annual Cut.—The cut of sawn and hewn timber for the five-year period, 1913 to 1917, amounted on the average to 51,571,400 superficial feet, or 4,298,000 cubic feet, not including firewood and other minor forest products, which may be estimated at 5,221,825 cubic feet. This represents a cut per acre, on the basis of 4 million acres of commercial forests, of 1.1 cubic feet of saw timber, and 2.4 cubic feet for both saw timber and firewood.

Exports and Imports.—In 1913 Tasmania imported 336,583 cubic feet of timber, or the least of any Australian colony. On the other hand, it exported about 2,083,333 cubic feet. In values, the average timber exports and imports are approximately as follows:

Exports	$534,600
Imports	$145,800

Domestic Consumption.—The average annual cut of saw timber amounts to 4,298,000 cubic feet. The net exports are 1,746,750 cubic feet, which leaves 2,551,250 cubic feet for domestic consumption, or 12.2 cubic feet per capita. The total consumption of sawtimber and firewood would be 7,773,075 cubic feet, or 37.2 cubic feet per person.

Forestry Movement.—Until 1921, Tasmania had no forest department nor any agency for the proper handling of forests. The result was that while the forests and the amounts of timber cut on the average for the last 10 years were the same in Tasmania as in Victoria, the latter now has a forest revenue close to $340,200, while the revenue of the former has been stationary at about $19,440. Victoria, while actually cutting rather less timber than Tasmania, has an efficient forest department and has 15 times the forest revenue. Tasmania, with 132 sawmills, had a revenue of only two-thirds that of South Australia with its small forest industry.

In 1921 a Forestry Department was created. It has control of all state forests and timber reserves, maintains plantations and nurseries, and distributes planting material. It exercises supervision over cutting in private forests, to insure reproduction, eliminate wasteful methods, and prevent fires. It also is charged with the development of forest policies and the promotion of forestry in general.

Forest Industries.—In 1913 there were 132 sawmills in Tasmania, representing an invested capital of $1,156,680; 1,751 persons were em-

ployed in the sawmills and they earned $729,000. The value of the products turned out was $1,579,500. The sawmills in or near the forests were reported a few years before the war as producing 45 million superficial feet yearly, or about 3,750,000 cubic feet of timber. This is nearly one-third of the total yearly export from Australia. Tasmania is behind every other Australian state in forestry. A few more years of the present situation will see the remaining forests of Tasmania reduced to worthless scrub.

Victoria

Forest Area.—Victoria, the southeastern state of the Australian group, has a total land area of 56,243,200 acres. Of this, the wooded area is about 8,000,000 acres, of which some 4,150,000 acres is in timber and climatic reserves. The population is 1,430,758 and the per capita forest area 5.6 acres. The total forest area and the percentage of the land area covered by forest are given in Table 398.

TABLE 398.—FOREST AREA, VICTORIA

	Agricultural land	Forest			Other land	Total
		Merchantable	Unproductive or inaccessible	Total		
Acres	28,000,000	2,999,680	2,999,680 [1] 2,000,640 [2]	8,000,000	20,243,200	56,243,200
Percentage of total area	49.8	5.3	8.9	14.2	36.0	100

[1] Mountain forest. [2] Mallee scrub.

Character of the Forest.—The forests of Victoria may be divided, according to their topography and the species composing them, into four divisions, as follows:

1. The coastal region.
2. The mountain region.
3. The foothills.
4. The river bottoms.

The forests are composed principally of different species of eucalypts. Commercially the forest area may be divided into:

(a) Three million acres of merchantable forest, mainly situated along the Dividing Range from the Grampians to Cape Howe and to the source of the River Murray. The commercial forests occur also in the basins of the Murray and other northern rivers and the lower Glenelg in the southwestern district.

(b) Three million acres of inaccessible forest in the more rugged portions of the mountain region, extending from the sources of the River Yarra northeastward to the head of the River Murray, and thence southeast towards Cape Howe.

(c) Two million acres in the northwestern portions of the state known as the Mallee, bearing at intervals a thick growth of stunted eucalypts, so-called Mallee scrub, and interspersed with belts of white cypress pine (*Callitris robusta*) and belar (*Casuarina lepidophloia*).

Victoria has some 20 species of the eucalyptus family which are of a high commercial value. They may be divided into two main classes according to their hardness, durability, toughness, and general utility. The eucalypts belonging to the first class are:

Red gum (*E. rostrata*)
Red ironbark (*E. sideroxylon*)
White ironbark (*E. leucoxylon*)
Grey box (*E. hemiphloia*)
Blue gum (*E. globulus*)
Spotted gum (*E. goniocalyx*)
New South Wales blackbutt or flintwood (*E. pilularis*)
Yellow stringybark (*E. muelleriana*)
Gippsland mahogany (*E. botryoides*)

In the second class may be placed:

Messmate (*E. obliqua*)
White mountain ash (*E. regnans*)
Red ash (*E. delegatensis*)
Three stringybarks (*E. macrorhyncha*, *E. capitellata*, and *E. piperita*)
Bloodwood (*E. corymbosa*)
Silvertop (*E. sieberiana*)

There are some 40 species of forest trees, many of which, however, are of small size and confined to limited areas. Among these are blackwood (*Acacia melanoxylon*), evergreen beech (*Fagus cunninghami*), and several species of acacia, which yield tanning bark of good quality.

Character of Ownership.—Table 399 gives the classification of the forest area by ownership.

Annual Growth.—The average gross annual growth in all forests of fair quality has been estimated at 360 superficial feet, or 30 cubic feet, per acre. Five cubic feet are allowed for loss through fire, natural decay, and waste, leaving 25 cubic feet as the average annual net growth per acre. The average gross annual growth for the entire forest area, exclusive of Mallee scrub (3,126 square miles), is estimated at 180 million cubic feet; the loss from fire for the same area at 3,600,000 cubic feet, and the loss through waste and decay at 27 million cubic feet, or a

TABLE 399.—OWNERSHIP OF FORESTS, VICTORIA

Item	Area belonging to					Total
	State			Corporate bodies	Private individuals	
	Dedicated to timber production	Other forest	Total			
Acres	4,160,000	3,520,000	7,680,000	120,320	199,680	8,000,000
Percentage of total area	52	44	96	1.5	2.5	

total loss of 30,600,000 cubic feet. The average annual net increment for the entire area is 149,400,000 cubic feet.

Annual Cut.—The annual cut of timber and firewood, and also the production of other materials from the forests, are shown in Table 400.

TABLE 400.—ANNUAL PRODUCTION OF TIMBER AND OTHER FOREST MATERIALS, VICTORIA

Kind of product	Quantity	Value at the place of preparation
Under state control:	*cu. ft.*	
Timber	7,500,000	$3,280,500
Fuel (402,800 tons)	20,140,000	489,402
Wattle (acacia) bark (500 tons)	.....	17,010
Charcoal (230 tons)	.....	56,498
Eucalyptus oil (360 tons)	.....	261,274
Other:		
Timber	833,300	364,500
Fuel (box and ironbark)	20,000,000	972,000
Tanbark (4,000 tons)	.....	116,540
Total	48,473,300	$5,557,824

Exports and Imports.—The average annual imports and exports for the five fiscal years from 1914 to 1918 are given in Table 401.

TABLE 401.—ANNUAL IMPORTS AND EXPORTS OF TIMBER, VICTORIA

Year	Exports	Imports
	cu. ft.	*cu. ft.*
1913–14	9,100	14,196,000
1914–15	111,100	11,326,500
1915–16	73,500	11,101,250
1916–17	78,600	7,184,000
1917–18	18,200	8,020,500
Average for five years	74,900	10,365,550

As a matter of fact, there are practically no exports overseas of indigenous hardwoods. The quantities shown as exports are in reality transfers of manufactured timber to neighboring states. Even the exports to neighboring states are very small. The only forest product which is being exported in any quantities is eucalyptus oil, the annual production of which is about 360 tons (806,400 pounds), largely exported to Great Britain and the United States of America.

Victoria imports about 45 per cent of its total consumption of timber. The imports consist largely of softwoods, which before the war were obtained chiefly from Norway, Sweden, the United States, Canada, and New Zealand. Since the war, imports of Baltic red and white pine for floorings, finishings, and weather boards have almost ceased, as native hardwood is now largely substituted for weather board and flooring; and 3-ply sheets of pressed pulp, such as beaver board, and sheets of stamped metal or plaster are being used for finishings. Douglas fir (Oregon pine) is still largely imported for framing in building construction, as are also sugar pine and yellow pine from California for joinery and shelving, California redwood for door and window stocks and interior finish, New Zealand kauri pine and rimu for flooring and plain cabinet work, and New Zealand white pine for butter boxes.

Domestic Consumption.—The average annual cut of timber and fuel amounts to 48,473,300 cubic feet. In addition, there is being imported annually in excess of exports 10,290,650 cubic feet, making a total consumption of 58,763,950 cubic feet. With a population of 1,430,758 this represents a per capita consumption of 41.1 cubic feet. The per capita consumption of saw timber is 13.0 cubic feet, and of firewood 28.1 cubic feet.

Lumber and Wood-Using Industries.—As regards the extent of the lumber and other wood-using industries, the statement given in Table 402 of the amount of timber consumed, the value of the manufactured

product, and the number of persons employed may give a fair idea of the situation.

TABLE 402.—TIMBER USED AND RELATED DATA, VICTORIA

Industry	Amount of timber consumed	Value of product at the place of preparation	No. of persons employed
Forest sawmills	8,333,000 cu. ft.	$3,645,000	2,000
Sleeper hewing	750,000 cu. ft.	243,000	120
Pile and beam cutting	250,000 cu. ft.	.....	.....
Pole cutting (telegraph and telephone)	75,000 cu. ft.	43,740	25
Charcoal kilns	230 tons	56,498	30
Mining timber	750,000 cu. ft.	276,048	50
Fencing timber	469,000 cu. ft.	51,030	60
Fuel cutting	40,140,000 cu. ft.	1,461,402	400(?)
Tan bark (acacia)	4,500 tons	153,090	50
Eucalyptus oil stills	806,400 lbs. (360 tons)	261,274	300
Wood distillation (one factory)	8,300 cu. ft.	24,300	20
Seasoning kilns (2)	125,000 cu. ft.	97,200	25
Chair factories (1)	20,000 cu. ft.	29,160	20
Tool-handle making (1)	10,000 cu. ft.	19,440	20
Cooperage	40,000 cu. ft.	174,960	106
Cabinet and billiard-table making	50,000 cu. ft.	2,549,556	1,840
Total	51,020,300 cu. ft.[1]	$9,085,698	5,066

[1]This evidently includes some duplication.

In addition to the industries mentioned in the above table, a considerable amount of charcoal, tanbark, and eucalyptus oil is produced in Victoria. Charcoal is prepared chiefly from red gum (*E. rostrata*) and grey box (*E. hemiphloia*). It is used mainly by producer-gas plants in providing electric light for small inland towns, and also by country blacksmiths and wheelwrights. Tanbark is obtained from two acacias (*A. mollissima* and *A. pycnantha*). Eucalyptus oil is obtained from five species: peppermint (*E. amygdalina*), blue mallee (*E. polybractea*), blue gum (*E. globulus*), red ironbark (*E. sideroxylon*), and white ironbark (*E. leucoxylon*). Oil from blue mallee and blue gum is largely used in pharmacy in Europe and the United States; the oil from the other species is used largely in the flotation of metals.

The Forestry Movement.—In 1918 there was created a Commission of Management with wide powers. The commission is empowered to fix rates and charges for forest produce, purchase land or acquire it by

exchange, carry on logging and sawmilling and other forest industries, purchase, graze, and dispose of sheep and cattle, construct and maintain roads, tracks, and tramways, and prepare and control working plans for the proper regulation of the yield of forest products. An annual appropriation of $194,400 is authorized for the development of forestry. This sum is being increased on the basis of half the annual forest revenue when the latter exceeds $388,800. The commission, which is also charged with the task of surveying mountain forests and recommending their permanent reservation, consists of three members, who are appointed for a term of five years and may be reappointed for a similar term of years. The field staff consists at present of 5 chief foresters, 21 foresters, and 14 assistant foresters, with a number of foremen, guards, and so on. There is also a plantations and nurseries branch under the general supervision of a chief superintendent with a staff of nurserymen, nursery foremen, etc. The members of the commission are not technical foresters, and there is no superior staff of forest officers in the employ of the commission. The forest personnel is made up exclusively of men trained in a small forest school established locally. The revenue and expenditures for the fiscal years 1914 to 1918 are given in Table 403.

TABLE 403.—FOREST REVENUE, VICTORIA

Item	1913–14	1914–15	1915–16	1916–17	1917–18
Revenue	$280,646	$344,253	$287,659	$245,989	$271,757
Expenditure	281,914	316,964	316,590	260,258	333,187
Net revenue per acre	$−0.0002	$0.004	$−0.004	$−0.001	$−0.008

One society interested in forestry is the Australian Forest League. This league was founded in Melbourne in 1912 with branches in each of the states of the Commonwealth. Since 1917 it has published a quarterly journal entitled "The Gum Tree," which has a circulation of 2,000 copies. A forest school, the first in Australia, was established in 1910 at Creswick on the Dividing Range, some 10 miles northward of Ballarat. Five hundred acres has recently been withdrawn from the state forest in the immediate vicinity of the school for experimental and demonstration purposes.

Probable Future.—The forest situation in Victoria is summarized in Table 404.

At present the net growth is much higher than the total consumption. Although Victoria will doubtless continue for a number of years to import softwoods for interior construction, such as door and window stock and

TABLE 404.—SUMMARY OF FOREST SITUATION, VICTORIA

Timber and fuel	Cut	Exports	Home consumption of home-grown timber	Imports	Total consumption of home-grown and imported timber	Net increment	Excess of increment over consumption
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Total.....	48,473,300	74,900	48,398,400	10,365,550	58,763,950	149,400,000	90,636,050
Per capita...	33.88	0.05	33.83	7.24	41.07	104.42	63.35

light framing for certain classes of building, imports of Baltic weather boards and flooring are not likely to assume the pre-war proportions. There is untouched virgin timber on some two million acres of forest. With improved methods of management there is no prospect of a shortage of supplies. A large supply of fuelwood is obtainable from dry girdled trees on private lands. Furthermore, the fuel situation will more and more be met by the development of the coal mines.

Western Australia

Forest Area.—The total land area of Western Australia is 624,640,000 acres (976,000 square miles). Of this, approximately 16,491,500 acres, or 2.6 per cent, is classed as forest land. With a population of 331,660

TABLE 405.—TOTAL AREA OF FOREST AND PROPORTION OF THE LAND AREA COVERED BY FOREST

Class of land	Merchantable		Unprofitable or inaccessible		Total	
	Area	Proportion of total area	Area	Proportion of total area	Area	Proportion of total area
Forest	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Jarrah.....	2,784,000	0.44	5,280,000	0.85	8,064,000	1.29
Karri.....	256,000	0.04	256,000	0.04	512,000	0.08
Wandoo.....	102,400	0.02	7,680,000	1.23	7,782,400	1.25
Tuart.....	5,120	0.00	128,000	0.02	133,120	0.02
Total forest...	3,147,520	0.50	13,344,000	2.14	16,491,520	2.64
Agricultural.....	.....	.....	.....	.....	45,968,640	7.34
Other.....	.....	.....	.....	.....	562,128,640	90.02
Total.....	.....	.....	.....	.....	624,588,800	100.0

this makes 50 acres per person. This acreage is far in excess of the area of commercial forest. It is now estimated that the existing commercial forest in Western Australia does not much exceed 3,000,000 acres, or less than half (0.48) of one per cent of the total area. According to C. E. Lane Poole, Conservator of Forests of Western Australia, the land may be classified about as given in Table 405.

Character of the Forest.—Most of the forests are found in the southwest. In the northwest there are many valuable timber trees, but none in stands deserving the name of forest. The forests of Western Australia are particularly characterized by eucalypts, although there are a few other commercially important trees of different families. The most important timber trees of Western Australia are listed in Table 406.

TABLE 406.—MOST IMPORTANT TREES, WESTERN AUSTRALIA

Com'n name	Botanical name	Qualities of wood	Uses
Jarrah.....	*Eucalyptus marginata*	Hard, durable, and beautiful. Very fire-resistant.	Furniture and cabinet work, carved goods, vehicles, building construction, bridge and wharf timbers, piles, poles, railway ties, packing cases, and veneers.
Karri.....	*Eucalyptus diversicolor*	Very similar to jarrah, but of greater strength.	Shipbuilding, rolling stock, poles, furniture and cabinet work, interior decorations, and veneer.
Tuart.....	*Eucalyptus gomphocephala.*	Tough and dense.	Wheelwright work, railway cars, and truck construction.
Wandoo.....	*Eucalyptus redunca, var. elata.*	Durable. When used in conjunction with steel no chemical action is set up between the two materials.	All purposes to which tuart is applied.
Grass tree	*Kingia australis*.....	Strong, tough, and pliable	Heavy brooms for street cleaning, high-grade brushes, insulation, and coarser kinds of paper.
Blackboy....	*Xanthorrhoea preissii.*	Fibrous, somewhat spongy..	Glucose, treacle, scents, alcohol, certain tar products from which two dyes have been obtained, and picric acid, which is used in explosives.
Sandalwood..	*Santalum cygnorum*..	Aromatic.....	Distillation of sandalwood oil, jewel boxes, etc.
Marri (red gum).	*Eucalyptus calophylla.*	Large quantities of gum....	Tanning material.
Yate.....	*Eucalyptus cornuta*...	Light colored, exceptionally strong. It is probably one of the strongest timbers of the world.	Wheelwright work generally. Used where the strongest shafts or frames of carts are required.

TABLE 406.—MOST IMPORTANT TREES, WESTERN AUSTRALIA—*Continued*

Com'n name	Botanical name	Qualities of wood	Uses
Native pear..	*Xylomelum occidentale.*	Dark brown, with a beautiful figure. When finished with a wax surface resembles moiré silk.	Fine furniture wood.
Blackbutt....	*Eucalyptus patens....*	Pale yellow wood of the same weight and strength as jarrah.	Farm implements and railway truck building.
Raspberry jam.	*Acacia acuminata....*	Heavy, with a strong scent resembling that of pressed raspberries. Very durable. Fence posts 70 years in the ground show no signs of decay.	Cabinet work.
River banksia.	*Banksia verticillata...*	Light colored, with a beautiful grain. The lightest of all timbers in the State.	Furniture wood.
Sheoak.....	*Casuarina fraseriana.*	Broad medullary rays; particularly beautiful when quarter sawn.	Excellent cabinet wood; good for ox yokes; used extensively for shingles.
Morrell.....	*Eucalyptus longicornis.*	Strong, hard, dense, has an interlocked grain. Dark brown.	Wheelwright work and tool handles; also mining timber.
York gum....	*Eucalyptus loxophleba.*	Dense, hard, heavy, with interlocked grain. Yellow brown, with a beautiful figure.	The best wood for nave, maul, and mallet wood; also used for felloes and other wheelwright work and wagon building.
Mallets.....	*Eucalyptus occidentalis.* *E. falcata.* *E. spathulata.*	Valuable for its bark.....	Used chiefly for tanning. Bark contains from 36 to 40 per cent of tannin.
Cedar.....	*Agonis juniperina..*	Light brown or yellow; very strong.	Most suitable for axe handles and other uses where hickory or ash is generally used.

Character of Ownership.—Table 407 shows the ownership of the commercial forests of Western Australia.

The government owns 93.6 per cent of all the commercial forests, while private individuals own only 6.4 per cent.

Annual Growth and Cut.—No figures are available as to the annual growth. An estimate places the net increment at 13,315,000 cubic feet. The cut of sawn and hewn timber in Western Australia is placed at 13,441,350 cubic feet, as shown in Table 408.

This probably is not the entire cut, which may be as much as 15,000,000 cubic feet. In the absence of complete statistics, however, the total

cut, exclusive of firewood and mining timber, is taken as 13,441,350 cubic feet, or 4.5 cubic feet per acre and 40.5 cubic feet per head of population. Mining timber and firewood probably amount to about 32,000,000 cubic feet. The average cut of sawtimber and firewood would be 15.1 cubic feet per acre of merchantable forest, or 2.8 cubic feet per acre of all forest.

Exports and Imports.—The average annual exports of timber (average for 11 years—1909–19) are 9,098,950 cubic feet, valued at $3,360,000. The average annual imports for the same period were 911,050 cubic feet, valued at $475,323, giving an excess of exports over imports

TABLE 407.—FOREST OWNERSHIP, WESTERN AUSTRALIA

Kind of forest	State			Private	Total
	Dedicated to timber production	Other forest	Total		
	acres	*acres*	*acres*	*acres*	*acres*
Jarrah	.....	2,688,000	2,688,000	96,000	2,784,000
Karri	.....	256,000	256,000	.....	256,000
Wandoo	.....	.....	.....	102,400	102,400
Tuart	3,200	.....	3,200	1,920	5,120
Total	3,200	2,944,000	2,947,200	200,320	3,147,520
Per cent	0.1	93.5	93.6	6.4	100

TABLE 408.—ANNUAL CUT, WESTERN AUSTRALIA

Kind of wood	Quantity	
	Hewn, sawn, or squared	Equivalent in the log
	cu. ft.	*cu. ft.*
Jarrah	12,567,650	37,702,950
Karri	714,050	2,142,150
Tuart	40,950	122,850
Wandoo	39,650	118,950
York gum, morrell, yate, jam	79,050	237,150
Total quantity	13,441,350	40,324,050
Total value	$4,524,096.24	

of 8,187,900 cubic feet, valued at $2,885,000. Table 409 gives the imports and exports by countries of destination and origin.

TABLE 409.— IMPORTS AND EXPORTS, WESTERN AUSTRALIA

Country of— A: Destination B: Origin	A—Exports		B—Imports		Balance—Plus or Minus	
	Quantity	Value	Quantity	Value	Quantity	Value
	cu. ft.		*cu. ft.*		*cu. ft.*	
United Kingdom	718,100	$276,680	10,250	$5,652	+ 707,850	+ $271,028
Ceylon	125,300	41,179	.....	10	+ 125,300	+ 41,169
India	1,798,400	557,549	16,750	9,229	+1,781,650	+ 548,320
Mauritius	25,000	9,725	.....	.....	+ 25,000	+ 9,725
Natal (to 1914)	453,950	124,703	.....	.....	+ 453,950	+ 124,703
New Zealand	696,600	288,431	50,400	27,595	+ 646,200	+ 260,836
Singapore	6,600	2,517	.....	.....	+ 6,600	+ 2,517
Argentine	68,250	26,429	.....	.....	+ 68,250	+ 26,429
Belgium	108,650	42,632	200	87	+ 108,450	+ 42,545
Egypt	283,550	111,440	.....	.....	+ 283,550	+ 111,440
France	250	87	50	24	+ 200	+ 63
Germany	17,550	7,159	8,200	4,564	+ 9,350	+ 2,595
Holland	550	209	450	214	+ 100	− 5
Java	1,050	403	150	68	+ 900	+ 335
Philippine Islands	46,800	18,215	700	87	+ 46,100	+ 18,128
Portuguese East Africa	105,350	40,284	.....	.....	+ 105,350	+ 40,284
Uruguay	133,300	51,817	.....	.....	+ 133,300	+ 51,817
Cape Colony (to 1914)	561,400	220,333	.....	.....	+ 561,400	+ 220,333
China	38,500	15,275	200	107	+ 38,300	+ 15,168
Straits Settlements	350	136	16,550	6,857	− 16,200	− 6,721
Brazil	16,750	6,503	.....	.....	+ 16,750	+ 6,503
Italy	350	151	150	83	+ 200	+ 68
Hongkong	200	73	.....	.....	+ 200	+ 73
United States of America	.....	15	470,350	244,045	− 470,350	− 244,030
South Africa (since 1914)	649,350	259,879	.....	10	+ 649,350	+ 259,869
Ocean Island	300	122	.....	.....	+ 300	+ 112
Tonga, Pacific Islands	50	19	.....	.....	+ 50	+ 19
Canada	.....	.....	1,850	894	− 1,850	− 894
Russia	.....	.....	8,600	5,288	− 8,600	− 5,288
Switzerland	.....	.....	.....	5	−	− 5
Sweden	.....	.....	117,600	61,562	− 117,600	− 61,562
Norway	.....	.....	41,300	22,059	− 41,300	− 22,059
Austria	.....	.....	.....	5	−	− 5
Japan	.....	.....	22,450	12,024	− 22,450	− 12,024
Siam	.....	.....	1,000	496	− 1,000	− 496
East Indies	.....	.....	200	102	− 200	− 102
Borneo	.....	.....	.....	5	−	− 5
Commonwealth of Australia (eastern states)	3,242,450	1,258,725	143,650	74,251	+3,098,800	+ 1,184,474
Grand total	9,098,950	$3,360,680	911,050	$475,323	+8,187,900	+$2,885,357

The imports come chiefly from the United States of America, Sweden, New Zealand, Norway, and Japan, and consist almost exclusively of coniferous lumber and timber. In other words, Western Australia exports chiefly hardwoods and imports conifers.

Domestic Consumption.—If we deduct from an annual cut of 13,441,350 cubic feet the 8,187,900 cubic feet which is the excess of exports over imports, there remains only about 5,253,450 cubic feet for domestic consumption, not including firewood and other minor products. This gives a per capita consumption of about 16 cubic feet. The domestic consumption of both sawlog timber and firewood is 37,253,450 cubic feet, or 112 cubic feet per person. The consumption of firewood is 96 cubic feet per capita.

Forestry Movement.—For 90 years, from the foundation of the Western Australia Colony in 1829 until 1918, the vast forest wealth of this region was to all intents and purposes at the disposal of any and all who cared to avail themselves of it. In 1918, however, an act was passed establishing a Forests Department, which has the entire control and management of all matters of forest policy, all state forests and timber reserves, and the forest products of other crown lands. The Forests Department is charged with planting or thinning forests, making plantations and nurseries, and distributing trees from them to settlers. One of the features of the forest law is that private plantations of 10 acres and over are to be exempt from local government taxation and that settlers who take up land under the conditional purchase clauses of the land act must reserve two per cent of the acreage for the production of timber or other forest products. Three-fifths of the net revenue from the forests is placed to the credit of a special account, and forms a fund for the improvement of state forests and the development of forestry. The Forests Department is therefore not affected by shifting political changes.

TABLE 410.—SUMMARY OF FOREST CONDITIONS, WESTERN AUSTRALIA

Item	Squared timber (hewn and sawn)	Equivalent in round timber	Squared timber per capita
	cu. ft.	*cu. ft.*	*cu. ft.*
Cut (1)	13,441,350	40,324,050	40.5
Exports (2)	9,098,950	.....	27.4
Home consumption of home-grown timber (1−2)	4,342,400	.....	13.1
Imports (3)	911,050	.....	2.7
Total consumption (1−2+3)	5,253,450	.....	15.8
Net increment (4)	.....	13,315,000	.....
Excess of cut over increment (1−4)	.....	27,009,050	.....

Probable Future.—The forest situation in Western Australia may be readily inferred from Table 410.

It is thus clear that Western Australia is overcutting her forests at the rate of 27,000,000 cubic feet a year. In estimating the probable duration of supplies, a factor to be taken into account is the extent to which the forest areas which do not contain the best merchantable timber can be profitably utilized. It is more than likely that with the rise in price and the cutting out of the larger merchantable timber a use will be found for the inferior timber, which extends over an area of 13,440,000 acres in addition to the area of merchantable forest. As to the present merchantable forest, it is claimed that there is today no area of virgin jarrah forest which can sustain a large sawmill for 10 years. Fifteen years will see the disappearance of the large sawmills, and in their place there will probably spring up a large number of small mills which will utilize the trees left behind as valueless at the first logging. With forest practice and protection against fire, the cut-over forest lands of Western Australia may be made to produce for all time 100 cubic feet of timber per acre per year, a yield far exceeding the European forest yields, and thus continue to be an important source of hardwood timber.

British New Guinea (Papua)

New Guinea, frequently described as the largest island in the world, lies to the north of Australia. Its estimated area exceeds 200,000,000 acres (312,500 square miles), the greatest length being 1,490 miles and the greatest breadth 430 miles. The island was originally divided between the Netherlands, Great Britain, and Germany. The whole of the portion west of the 141st degree of latitude, comprising about 97,000,000 acres (152,000 square miles), or half of the island, belongs to the Netherlands. The eastern half, which was originally divided in almost equal portions between Great Britain and Germany, is now entirely in British possession. The area now owned by Great Britain, without the adjacent islands, is about 102,745,600 acres (160,540 square miles). The German protectorate included the northern part of the eastern half of the mainland known as Kaiser Wilhelm Land, and the large islands of the Bismarck Archipelago and the Solomon group, as well as nearly 200 smaller islands. The southeastern portion of New Guinea nearest Australia was a dependency of the Commonwealth of Australia. The German Pacific protectorate was terminated in 1914.

Although Dutch New Guinea is a part of Oceania, it has been described with the Dutch East Indies under Asia. The forest area of entire New Guinea, however, has been included in the area given for Oceania.

TABLE 411.—FOREST AREA, NEW GUINEA

New Guinea	Total forest area	Per cent of land area under forest	Forest area per capita
	acres		*acres*
British	82,196,000	80.0	164.4
Dutch	77,824,000	80.0	194.6
Total	160,020,000	80	177.8

The forests of British New Guinea (Papua) are very similar to the forests of Dutch New Guinea, which have already been described. There is a large diversity of useful timbers in Papua. Of 120 species that have been studied, 16 are adapted to resisting heavy strains, and are suitable for girders and railway cars; 10 for railway cars and carriage building; 15 for joinery and flooring; 14 for butter tubs; 5 for boat building; 4 for piles; and 15 for cabinet work. Sandalwood is indigenous to the island. It is largely used for cabinet work and santal oil is distilled from its roots. Ebony is being cut for export; rubber is a promising industry. Drugs, dyewoods, and spices are obtained in large quantities from indigenous plants. In the mountains there are coniferous forests, chiefly of pines, which offer possibilities in the shape of turpentining and timber for construction. The conifer *Agathis alba* yields a valuable resin. There are several sawmills, but their output has not yet been sufficient to supply the local demand for building and other timber, and large quantities of sawn timber have been imported from Australia. Contracts have been made by residents to ship timber to Great Britain. Timber licenses in force during 1917 covered 51,215 acres.

Reference

Official Yearbook of the Commonwealth of Australia, No. 12, 1918, p. 1045.

NEW ZEALAND

Forest Area.—The total land area of New Zealand is 66,291,840 acres (103,581 square miles). Of this, 17,073,920 acres (26,678 square miles), or 25.7 per cent, is classed as forest land. In the early days of the colony the greater part of the North Island was covered by dense forests. On the South Island the western coast and southland as far as the Chitha River on the east was also forested, but the greater part was open country. As a result of forest fires and extensive logging, the area under forest has been reduced from 21,196,800 acres (33,120 square

miles) in 1886 to 17,073,920 acres (26,678 square miles) in 1909, or 81 per cent of the original area. The classification of land in New Zealand is given in Table 412.

TABLE 412.—LAND CLASSIFICATION, NEW ZEALAND

Item	Agricultural land under cultivation	Land under forest	Other land	Total
Acres	17,613,440	17,073,920	31,604,480	66,291,840
Percentage of total area	26.6	25.7	47.7	100

The 17,073,920 acres (26,678 square miles) of forest land, however, is not all commercial forest. No information is available regarding the privately owned forests, but judging from the fact that of the 10,478,080 acres of state forests only about 1,371,000 acres is of saw timber size, the actual commercial forest area of New Zealand cannot be more than about 1,920,000 acres (3,000 square miles), or 2.9 per cent of the total land area.

The amount of standing timber in the country was officially estimated in 1910 at 33 billion board feet (2,756,000,000 cubic feet). Table 413 gives the amounts of different kinds of timber, according to ownership.

TABLE 413.—STANDING TIMBER, NEW ZEALAND

Species	On crown land	On private land	Total
	million cu. ft.	*million cu. ft.*	*million cu. ft.*
Kauri	18	23	41
Totara	25	23	48
Matai	113	172	285
Rimu	722	558	1,280
Kahikatea	94	121	215
Beeches	302	64	366
Miscellaneous	262	259	521
Total	1,536	1,220	2,756

Character of Forest.—New Zealand forests are usually of a mixed character, some one or two species predominating. It is seldom that large areas of forest consist of a single species only, although there are

noteworthy exceptions such as the mountain forests of beech, and large forests of white pine and of kauri. Although the principal species are distributed throughout the entire colony, certain districts may be roughly defined as particularly characteristic of a certain species. Thus the following districts may be distinguished:

Kauri District.—That part of the Colony lying north of a line drawn from Tauranga to Port Waikato. Kauri is the predominant tree.

Kahikatea (white pine) District.—The extensive swamps of the northern Wairoa and other rivers.

Totara District.—Although widely distributed throughout the Colony, totara forms the largest forest in the central and eastern portions of the North Island. Large areas of it are also found in many parts south of the lower Wairoa in the southern part of Hawke's Bay, the northern portion of the Wellington District, and the Seventy Mile.

Rimu (red pine) District.—The low land of the South Island below a level of 1,000 feet.

Beech District.—The portion of the South Island between 1,000 and 4,000 feet altitude.

Although there are approximately 100 native species of forest trees in New Zealand, only about 9 are of commercial importance. These are given in Table 414.

TABLE 414.—PRINCIPAL TREES, NEW ZEALAND

Native name	Botanical name	Quality of wood	Uses
Kauri	*Agathis (Dammara) australis*	Trees usually from 80 to 100 feet high and 4 to 12 feet in diameter; bark thick and resinous. Timber yellowish to brown, straight grained, firm, clean, silky, of great strength, toughness, and elasticity. Very durable	Finest tree in New Zealand and one of the largest timber-producing trees in the world
Totara	*Podocarpus totara*	Timber clean, straight in grain, compact, and very durable; easily worked, as it does not warp or twist. Many specimens resemble Honduras mahogany in general appearance. Particularly durable in contact with the ground and resistant to attacks of teredo	Occasionally used for ornamental planting, hedges, and windbreaks. Excellent for general building purposes, weather-boards, ties, telegraph poles
Matai (black pine)	*Podocarpus spicata*	Wood smooth, even, strong, durable, heavy, and easily worked. Liable to shakes	Ties, flooring, building, bridge construction. Bark sometimes used by tanners

TABLE 414.—PRINCIPAL TREES, NEW ZEALAND—*Continued*

Native name	Botanical name	Quality of wood	Uses
Rimu (red pine)	*Dacrydium cupressinum*	Logs can be obtained up to 4 feet in diameter. Heart of old trees sometimes very resinous and affords timber of great durability. Not durable in contact with the ground	Ordinary building purposes
Kahikatea (white pine)	*Podocarpus dacrydioides*	Wood firm, compact, tough, strong, straight in the grain, but not durable in contact with the ground. Logs remarkably sound except in unfavorable situations, where it is liable to be attacked by a small boring beetle	Used for variety of purposes, including butter-boxes
Puriri	*Vitex littoralis*	Wood very hard, dense, heavy, strong, and durable. Usually necessary to use explosives to split trees	Excellent for fence posts; used also in boat-building and for railroad ties
Tawhai rauriki	*Fagus solandri*	Heavy, tough, strong, durable. Wood greyish or pale red. Heartwood black and irregular in outline. If cut when matured and before decay commences it is of high value, but if felled too early or too late it perishes rapidly	In great demand for construction work of all kinds, including bridge building
Tawai	*Fagus menziesii*	Very straight in the grain, even, compact, hard, and dense. Very strong, tough, and elastic, but not durable when exposed to the weather	Used for all general purposes under cover
Tawai	*Fagus fusca*	Wood red, straight, compact, strong, tough, and very durable. Mature trees split easily	Used for railway ties, piles, general construction, mining, bridge-building, and particularly for fence posts.
Rata	*Metrosideros lucida*	Wood heavy, dense, and durable	Used for the same purposes as puriri

Character of Ownership.—The total area controlled in 1919 by the state was 10,478,080 acres, or 16,372 square miles, and by private and native interests 6,595,840 acres, or 10,306 square miles. In other words, 61 per cent of the forest is state-controlled and the remaining 39 per cent is in private and other hands.

The ownership of the forests in New Zealand is as follows:

Crown forests.....	13 per cent of total land area	= 8,367,360 acres
Permanent reserves..	3 per cent of total land area	= 2,110,720 acres
Alienated forest.....	10 per cent of total land area	= 6,595,840 acres
Total.....	26 per cent of total land area	=17,073,920 acres

Annual Growth.—No figures are available for the annual growth over the entire forest area of New Zealand. There is no doubt, however, that the present cut far exceeds the growth of the natural forests. The total annual growth probably does not exceed 34 million cubic feet. In order to meet the requirements a planting program involving some 700,000 acres, especially of fast-growing species such as Monterey pine (introduced from the United States) and poplars, is contemplated.

Annual Cut.—The average annual cut of saw timber is estimated at 500 million superficial feet per annum, or 42 million cubic feet, equal to about 764,000 tons of 55 cubic feet each. This for an area of sawlog timber of 2 million acres represents an annual cut of 21 cubic feet per acre, but evidently does not include firewood. Kauri, the most important commercial tree of New Zealand, is being cut at the rate of 52 million superficial feet per annum. At this rate the supply will not last more than 7 or 8 years longer. The second important timber tree is white pine. This is being cut, according to an official estimate, at the rate of 92 million superficial feet per annum; according to some other estimates at 108 million superficial feet. At the first estimate white pine will last only 10 years; at the second estimate 9 years. At the present rate of cutting it is estimated that the lumber in the New Zealand forests will be exhausted within about 28 to 30 years. The annual cut of firewood and other minor products is estimated at 25 million cubic feet, making the total cut about 67 million cubic feet.

Exports and Imports.—The foreign timber trade of New Zealand for the years 1014, 1919, and 1920, is given in Table 415.

TABLE 415.—EXPORTS AND IMPORTS, NEW ZEALAND

Year	Exports		Imports	
	Quantity	Value	Quantity	Value
	cu. ft.		*cu. ft.*	
1914.....	6,945,329	$2,056,315	3,214,006	$1,783,178
1919.....	4,143,889	2,140,944	770,590	706,592
1920.....	5,805,334	3,394,809	2,106,739	2,639,390

The bulk of the exports goes to the states of the Australian Commonwealth, the largest amount being taken by New South Wales and Victoria, and, to some extent, to the Pacific Islands. The imports are largely from the United States and Canada (66.6 per cent). Some forest products, such as lath and shingles, come entirely from the United States and Canada.

The New Zealand government has recently issued regulations under which the Board of Trade is to restrict the exportation of lumber. It is necessary to secure an export license from the Board of Trade in order to export any lumber. This measure is taken in order to conserve the rapidly diminishing supply of the country, in the hope of retaining sufficient to satisfy home demands so far as the different grades of lumber are concerned, especially white pine and kauri.

The chief ports through which timber trade takes place are Auckland and Wellington in the North Island and Christchurch and Dunedin in the South Island. While the values of exports and imports do not differ greatly, the quantity of exports is more than double that of imports.

Domestic Consumption.—The cut of native lumber in New Zealand increased from 13,645,000 cubic feet in 1886 to about 42,000,000 cubic feet in 1914. Since the exports exceed the imports by about 3,750,000 cubic feet (45 million superficial feet), the home consumption must be in the neighborhood of 38,000,000 cubic feet (456 million superficial feet). With a population of about 1,060,000 people this represents a per capita consumption of sawlog material of 36.1 cubic feet. The Under Secretary for Lands in his annual report dated May 30, 1915, estimated that the probable annual consumption in 30 years from then, when the present supplies of native timber will be exhausted, will be in the neighborhood of 60,000,000 cubic feet annually. The Royal Commission on Forestry, which made inquiry into the timber situation in New Zealand, estimated that in 30 years the probable annual consumption will be about 60 million cubic feet. According to the commissioners, the nature and kind of timber required will be as follows:

1. Pines, various kinds, for building purposes.
2. Australian gums (eucalypts).
3. Timber for boxes for the packing of agricultural and other produce.

Besides sawlog material, about 25,000,000 cubic feet of firewood, fence-posts, and other small material is consumed annually, making the total consumption slightly over 63,000,000 cubic feet, or 59.7 cubic feet per capita.

Lumber Industry.—As regards the number of men employed and the amount of money expended in wages, the timber industry in New Zealand is probably first among the industries, although the value of the product is not so great as that of some other lines. Although the timber

exports of New Zealand represent a large quantity in volume, they amount to only about 1½ per cent of the total value of exports of the country.

The Forestry Movement.—In 1919 a separate Department of Forestry was established in New Zealand. It is under the direction of the Director of Forests, who has the assistance of research officers, forest inspectors, and other staff. The Ministerial head of the Department is the Commissioner of State Forests. The Commissioner of State Forests has the power to purchase and hire sawmills and machinery, cut and sell timber in state forests, and purchase private lands for addition to, and protection of, state forests. The government has also the power to set apart any crown lands as "provisional state forests." Provisional state forests, as distinct from the permanent state forests, are areas which the government has power to take back for settlement purposes if the occasion demands. Every afforestation project is declared to be a public work. The government is further empowered to make regulations for limiting the exportation of timber from New Zealand and for prohibiting the sale of standing timber or the granting of licenses to cut standing timber on public or private lands except subject to conditions which may be prescribed. As a matter of fact, the government has already taken advantage of the provision of this law. As the dairy, fruit, and other industries which use a large quantity of white pine were finding it impossible to obtain adequate supplies, measures were taken through the Board of Trade to limit the export of white pine to 40 per cent of the total production. This met with strong opposition from persons engaged in export trade, but the users of white pine in New Zealand insist that the export of this wood should be stopped entirely. As the matter stands now, regulations were published in 1919 prohibiting the sale of standing timber or the granting of licenses to cut timber on either public or private lands without first obtaining a license from the Governor-General. Up to 1919 a total area of 35,344 acres was planted with 75 million trees. The New Zealand Forestry League is very active in giving information on various matters in connection with forestry and in advocating scientific management of New Zealand forests.

Probable Future.—With restrictions now imposed upon export trade, the exports and imports will probably soon balance, and in a few years New Zealand is likely to become dependent upon foreign supplies of timber. To shorten the period of such dependence the New Zealand government has an ambitious plan of afforesting 700,000 acres of forest land which is to produce annually 60 million cubic feet of lumber. The plan calls for the annual planting of 14,000 acres. Meanwhile, however, the reduction in the export trade of New Zealand, the bulk of which went to Australia, will create new demands for lumber by the states of

the Australian Commonwealth, which received much of their timber supplies from New Zealand. Canada, United States, Japan, and eventually probably Siberia, will be the countries that can take advantage of these new markets.

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OCEANIA OR SOUTH SEA ISLANDS

Forest Area.—The total area of the South Sea Islands is 69,610 square miles (44,550,400 acres). Forest occupies approximately 35.7 per cent of the entire land area, or 16,000,000 acres. With a population estimated at 1,080,030 this makes 14.8 acres per inhabitant. Although the South Sea Islands will not play an important part in export timber trade, most of them will have enough timber for all local needs when their own forests are developed. Meanwhile many of them import structural timber from North America and Australia. The timber trade is carried on chiefly by sailing vessels, and the amount of timber imported is probably not more than 10 million cubic feet. Very little wood is used on the islands, and most of that is imported. The total consumption is hardly more than 10 cubic feet per capita, or 16,000,000 cubic feet altogether.

The most important of the South Sea Islands are Bismarck Archipelago, Solomon Islands, New Hebrides, New Caledonia, Guam, Hawaii, Tahiti, and Fiji Islands.

An estimate of the forest area of the various groups of islands of the South Sea is contained in Table 416.

Bismarck Archipelago and Solomon Islands

This group of islands is in part well wooded, with mangroves along the shores and dense rain forests in the interior mountains. Giant eucalypts like jarrah and karri, and mahogany-like woods, such as *Barringtonia* and *Cordia*, abound in some of these islands, and the high-priced *Cedrela australis* especially appears in forest stands. *Afzelia bijuga* and *Calophyllum inophyllum* are other promising woods, but they

occur only sparingly. These islands are still largely unexplored and unexploited. Extensive areas have been planted with coconut palm (*Cocos nucifera*) and rubber (*Ficus elastica* and *Hevea brasiliensis*).

New Hebrides and Santa Cruz Archipelago

The mountains are generally covered with forests. The most important trees are *Casuarina,* candlenut (*Aleurites triloba*), kauri pine, various species of *Ficus,* and a cedar which grows tall enough for masts.

TABLE 416.—EXTENT OF FORESTS IN THE SOUTH SEA ISLANDS

Melanesia

Political control	Island or group	Total forest area	Per cent land area under forest	Forest area per capita
		acres		*acres*
Great Britain	Louisiadi Archipelago	136,000	25	27.2
	Santa Cruz Islands	60,800	25	12.2
	Solomon Islands (part)	4,096,000	50	30.3
France	Loyalty Islands	73,920	11	3.7
	New Caledonia	494,000	11	8.8
Australian Commonwealth (formerly Germany)	Bismarck Archipelago	6,400,000	50	34.0
	Solomon Islands (Bougainville)	1,344,000	50	29.9
Great Britain and France jointly	New Hebrides	359,460	11	7.1
Total		12,964,180	39.3	25.7

Micronesia

		acres		*acres*
Great Britain	Gilbert Islands	.....	.....	.....
United States	Guam	6,400	5	.7
	Hawaii	1,031,840	25	4.0
Japan (formerly Germany)	Caroline Islands (except Yap)	[1]	.....	.....
	Marianne or Ladrones (except Guam)	[1]	.....	.....
	Marshall Islands	[1]	.....	.....
	Pelew Islands	[1]	.....	.....
Total		1,038,240	20.9	3.0

[1] Area very small.

Several of the trees of the New Hebrides produce white, transparent resin. Sandalwood is present in the islands to some extent. The Island of Vanikoro in the Santa Cruz group is densely timbered and contains a large amount of kauri pine.

New Caledonia and Loyalty Islands

The forest vegetation of New Caledonia resembles on the east coast that of New Zealand and on the west coast that of Australia. A great variety of fine timber trees, including some conifers, acacias, myrtles, and *Casuarina,* are found in the volcanic district. There is a scattered growth of niaouli, or *Melaleuca viridiflora,* a tree resembling *Eucalyptus,* which produces hard wood suitable for building and a medicinal oil.

TABLE 416.—EXTENT OF FORESTS IN THE SOUTH SEA ISLANDS—*Continued*
Polynesia

Political control	Island or group	Total forest area	Per cent land area under forest	Forest area per capita
		acres		*acres*
Great Britain	Fiji Islands	1,189,600	25	9.8
	American Island	41,600	25	138.7
	Cook Islands	17,760	25	2.9
	Ellice Islands	2,240	25	0.9
	Manahiki	1,920	25	1.9
	Niué (Savage Islands)	5,760	25	1.4
	Phoenix	2,560	25	42.7
	Pitcairn	320	25	1.9
	Tokelan Islands	1,120	25	2.2
	Tonga (Friendly Islands)	61,600	25	3.2
United States	Samoa or Navigators: Tutuila, Manua or Tau Island	42,560	70	7.1
France	Marquesas Islands	78,400	25	18.2
	Tuamotu or Lou Archipelago	58,240	25	11.6
	Society Islands (Tahiti, Kaukura, Faaiti)	101,920	25	5.5
	Austral Islands (Tubuai, Ravaivai)	17,600	25	8.8
	Uea or Wallis (Horne Islands)	6,400	25	1.4
New Zealand (formerly Germany)	Samoa or Navigators	441,280	70	13.4
Total		2,070,880	29.4	9.1
Grand total		16,073,300	35.7	14.8

According to the residents in the islands, the niaouli tree has a favorable effect upon the climate, which is very healthful. Of the other trees may be mentioned bancoulier or candlenut (*Aleurites triloba*), banana-tree (*Musa fehi*), and coconut palm. The inland forests are said to contain no less than 168 species of timber trees.

Guam

Guam is the largest, most populous, and most southern in position of the Mariana Islands. The Island of Guam is about 30 miles in extreme length and from 4 to 8½ miles in width. Its land area is 128,000 acres. Forests occupy only about 5 per cent, or 6,400 acres. Since Guam is one of the oldest and most thickly settled of the islands, the destruction of forests has proceeded much further there than on many of the other Pacific islands. For a population of 9,000, the per capita forest area is 0.7 acre.

Most of the forest is situated in the northern part of the island, although there is some in the southern part.

Ifil (*Intsia bijuga*) is the most important timber tree in Guam. The heartwood is very hard and heavy, but not elastic. Although it is cross-grained and hard to work, it is very durable and is used for the posts of the best houses. The wood is yellowish at first, but turns rust color, and in time assumes a dark color resembling that of black walnut. Although of coarse grain, it takes a fine polish. Nearly all of the better houses of the island have tables and settees made of it, and even floors, which are kept beautifully polished by rubbing them with grated coconut wrapped in a cloth through which the oil oozes. The wood has the virtue of resisting the attacks of termites, or white ants. Trunks 30 feet long and 40 inches in diameter are sometimes found, but they usually vary from 8 to 16 feet in length and from 1 to 24 inches in diameter. Houses made of newly-sawn ifil are not whitewashed or painted until the wood has had time to dry and season on account of the brown coloring matter which discolors the surface. As it grows old the wood becomes so hard that holes must be bored into it for nails. The trees are becoming scarce in the island and their felling for timber is strictly regulated by law.

Other hardwoods used in carpentry and joinery work are chopag (*Ochrocarpos obovalis*), principally used for ceilings and interiors, and also for joinery work; ajgao (*Premna gaudichaudii*), used as supports for the poorer classes of houses and for live fence posts; ufa (*Heritiera littoralis*), used for spokes of wheels, knees of boats, and especially for plows; daog (*Calophyllum inophyllum*), used for the solid wooden wheels of the carts drawn by oxen and carabao; and dugdug (*Artocarpus communis*), or a seeded variety of the breadfruit, which grows everywhere in

Guam. The seedless variety is too valuable as a fruit tree to be used for timber.

In addition there are a number of trees yielding fiber and oil, among which are coconut (*Cocos nucifera*), *Nypa fruticans,* and *Paritium tiliaceum.* The latter, the most important of all, is widely distributed over the tropical regions of the world. Ropes and twines are twisted from its inner bark. Copra is the principal product exported. Although no timber is exported, some is imported, particularly for the use of the naval establishment.

Territory of Hawaii

Forest Area.—The Territory of Hawaii, formerly known as the Sandwich Islands, is located in the northern Pacific, and consists of eight inhabited islands, of which only the following five are of importance: Kauai, Oahu, Molokai, Maui, and Hawaii, the largest of the group. The population of the islands is 255,900, and their total land area slightly less than 6,500 square miles, or about 4 million acres.

The soil is made up of volcanic deposit, of greatly varying age and quality. It is very fertile when weathered, but land covered by recent lava flow is practically useless. Probably one-third of the area is of this worthless character.

The area of indigenous forest is a little over one million acres, or 25 per cent of the land area. The per capita forest area is 4 acres. The area of true commercial forests, however, is small; the greater part of the forest is made up of low trees chiefly valuable as a protective watershed cover.

Character of the Forest.—Most of the forest vegetation of the Hawaiian Islands grows between 2,000 and 8,000 feet above sea level. The indigenous forest is distinctly tropical in character; the trees rarely exceed thirty feet in height. The tree growth falls into two naturally distinct types, and these types are in no case intermingled. They are: the timber-producing forests, growing on the coastal plains and on the lower slopes of weathered lava soil; and the protective forests, which extend far up the mountains and contain practically no timber of commercial value, but are of the greatest economic importance as protective cover.

The forests growing at low altitudes consist entirely of algaroba, or mesquite (*Prosopis juliflora,* covering about 90,000 acres. This species, which was introduced from America in 1828, serves many purposes, being suitable for fuel and fairly durable, while its pods furnish abundant and nourishing food for stock. It grows readily on soil unsuited to other vegetation, is hardy, and reproduces itself rapidly from both seeds and sprouts.

Few of the woods of the Hawaiian Islands are suitable for export. One of the best is koa (*Acacia koa*), known commercially as Hawaiian mahogany. This is an excellent cabinet wood, fine grained and beautifully colored. Another important timber tree is ohia lehua (*Metrosideros polymorpha*), a harder and heavier wood than mahogany and very durable, though it has the disadvantage of warping unless carefully handled, and has been little used hitherto except for fuel. This tree forms about three-fourths of the native forests, and is especially valuable as protective forest. Stands of this species are characterized by very luxuriant undergrowth of vines, ferns, and mosses.

Several species of sandalwood are native to the islands and at one time formed an important item of commerce, but indiscriminate cutting has depleted the supply until it is no longer sufficient for export trade. Minor species are mamene (*Sophora chrysophylla*), a good post timber; kukui (*Aleurites triloba*), or candlenut tree, useful only as protective forest; and a number of others, which form mixed stands and are quite without commercial value.

Ownership.—Of the 1,000,000 acres of forest land, 800,000 acres has been set aside as reserves. About 70 per cent of the area of these reserves is owned by the government. Table 417 shows the acreage of forest reserves in the five principal islands for 1919.

TABLE 417.—AREA OF FOREST RESERVES, HAWAIIAN ISLANDS

Island	Number of reserves	Government land	Private[1] land	Total
		acres	*acres*	*acres*
Kauai	8	81,325	66,888	148,213
Oahu	15	34,045	33,888	67,933
Molokai	1	13,268	31,406	44,674
Maui	7	74,980	46,148	121,128
Hawaii	16	355,037	81,754	436,791
Total	47	558,655	260,084	818,739
Per cent of total	.....	68	32	100

[1] The private lands within forest reserves are not protected or managed as reserves. The net reserved area is only that in public ownership.

Losses.—Up to about one hundred years ago the principal enemy of forest growth in the Hawaiian Islands was the overflow of lava from the volcanoes. Since that time, however, various other destructive agencies have been at work until the present area under forest is only a

very small proportion of the original. The introduction of cattle, pigs, and goats into the forests, where they were allowed to wander and feed unchecked until within the last few years, has been the cause of great destruction. Boring and leaf-eating insects have destroyed thousands of acres of timber; rank growths of grass have choked the young trees and made germination of seed impossible; severe fires have swept away large tracts; and careless cutting has depleted the forests and brought about a serious condition in regard to water supply and rainfall. The close relation between forests and rainfall is nowhere more clearly apparent than in the Hawaiian Islands. It is claimed that the water supply for irrigation has noticeably decreased and the rainfall has become irregular because of the destruction of the forests.

Cut, Imports, and Consumption.—None of the islands composing the Territory of Hawaii has sufficient timber to meet its own needs, even were the timber that is available best adapted to the uses to which it must be put. The forests are principally of the hardwood type, practically woodland in character, and therefore are of more value as a protection to the watersheds of the islands than for lumber. That these forests cannot be counted upon even for an abundant supply of fuel may be inferred from the fact that plantations of eucalyptus are being made to solve the fuel problem. A limited amount of ohia, a dense hardwood, is cut for railroad ties, vehicle stock, flooring, paving blocks, and lumber that is principally used for interior finishing purposes. Another species cut in small quantities, and which in a measure competes with lumber from the mainland, is koa, occasionally referred to as Hawaiian mahogany. Natives cut the timber and find a market for the logs and gnarled pieces. It is manufactured principally into furniture, and is also made into many small articles sold as souvenirs.

The total domestic cut cannot be more than about 3 million cubic feet a year, of which probably 2½ million is firewood and 500,000 is ties and sawlogs. The import on an average probably does not exceed 8 million cubic feet a year. It consists chiefly of lumber, shingles, box shooks, and a limited amount of logs and other round timber. The total consumption, therefore, may be placed somewhere in the neighborhood of 11 million cubic feet which, at a population of 255,900, is 43 cubic feet per capita. Of this, 33 cubic feet is lumber and 10 cubic feet firewood. This rather high consumption of lumber compared with other Pacific islands may be explained by the presence of large sugar plantations, which are heavy consumers of lumber for mills, store houses, living quarters, flumes for carrying water for irrigating or for fluming the cut cane, railroad ties, trestles, fences, vehicles, and many other uses incident to a plantation; also of the naval and war establishments, which need large quantities of lumber.

Several railway companies use considerable quantities of lumber for cars and ties, and wood is also in demand for trolley and telephone poles and for block paving.

Practically the entire import is from mills on the Pacific coast of the United States. Douglas fir forms the bulk of the lumber, but other species used to some extent are redwood and a small amount of hardwoods, including oak, ash, and hickory.

Industries.—There are no wood-using industries of any importance in the Territory. The only sawmill is that of the Hawaii Hardwood Company at Pahoa, Hawaii, which cuts ties, paving blocks, etc., from ohia and koa. The manufacture of furniture and novelties is carried on to a small extent.

Legislation.—Attempts have been made to offset the destruction of the forests by stringent regulation, by establishing forest reserves, and by reforestation. Much planting is being carried on, the eucalypts being the most successful species for this purpose.

Marshall, Gilbert, and Ellice Archipelagoes

Many of the atolls of these groups are densely wooded, but the forests apparently consist chiefly of palms.

Tonga or Friendly Islands

These islands contain several kinds of valuable timber trees. The value of timber imports in 1918, including both round and hewn timber, was $24,900.

Tahiti Archipelago (Society Islands)

The mountains of this group are generally covered with dense tropical forest. The principal species are:

Tamanu (mahogany); aito (ironwood), rosewood, banyan, purau (kind of *Hibiscus*), mara, algerabia, tira (Japanese lilac), courbary, autaraa, tamarind, cotton tree, bamboo, pandanus.

Exotic trees have almost wholly replaced native species in some parts of the coast region. Many timber and fruit trees have been introduced.

Most of the lumber imported comes from the United States. The demand for timber (redwood and Douglas fir) for houses is constant but not heavy.

Fiji Islands

The vegetation is tropical, with mangrove thickets in swampy localities, and palms, casuarinas, and acacias in other portions. The vegetation in general resembles that of Australia.

New Zealand farmers have made extensive rubber plantations, which are said to cover thousands of acres. Rubber exports amounted to

$57,500 in 1916. Imports of timber in the same year were valued at $67,500. The imports amount to about one million cubic feet, including shooks, rough and dressed lumber, and sash and door stock. The species imported are Douglas fir from the United States and Canada, kauri from New Zealand, and eucalyptus from Australia. Among the many valuable timber trees are: vesi (*Afzelia bijuga*); dilo (*Calophyllum inophyllum*), producing also a medicinal oil; and dakau or Fiji pine (*Dammara vitiensis*), which is related to the New Zealand kauri, but has become scarce. Paper mulberry is cultivated for the manufacture of a cloth, masi, which is beaten from its bark. Yasi or sandalwood was formerly abundant but is now scarce. The most important palm of the Fiji Islands is the coconut.

Samoa

The total land area of the Samoan Archipelago is 1,080 square miles or 691,200 acres, of which the islands of Tutuila, Anu, Ofoo, Oloosinga, Tau, and Rose belong to the United States of America, and have an area of 60,800 acres. The forests of Samoa occupy about 70 per cent of the land area, or 483,840 acres, and are remarkable for the size of the trees and the great variety of species. Coconut palm and breadfruit trees are of particular value to the inhabitants.

The only product of commercial importance is copra, the dry meat of the coconut. All the beaches are fringed with coconut palms. At the mouths of streams where the water is brackish there are mangrove thickets composed chiefly of *Rhizophora* and *Bruguiera*. Other common trees are: fau (*Hibiscus tiliaceus*); milo (*Thespesia populnea*); lama, or candlenut (*Aleurites moluccana*) called "kukui" in the Hawaiian Islands; toi (*Alphitonia excelsa*); tavai (*Rhus simarubaefolia*); masame (*Antidesma sphaerocarpum*); tamanu, a species of maba; fetau (*Calophyllum inophyllum*); futu (*Barringtonia speciosa*); ngatae (*Erythrina indica*); ifilele, which is identical with the valuable ifil of Guam (*Intsia bijuga*), is prized for its durable hard wood, and is much used for house posts; and giant banyans.

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CHAPTER IX

FOREST RESOURCES OTHER THAN TIMBER

In some of the less developed forest regions, particularly in the tropics, timber hitherto has been a far less important product than some of the secondary or minor forest products, such as rubber, dyewoods, gums, and vegetable oils. Even in countries whose forests are exploited chiefly for their timber, such products as resin, tanbark, and cellulose are the raw materials for large and growing industries. This is the case, for instance, in southern France, southeastern and northern United States, northern Europe, and Canada. An exhaustive treatment of all these secondary products would be a more formidable undertaking than the description of the timber resources themselves, and is outside the scope of this book.

There is no more attractive and profitable field of research than the study of the forest by-products of the world, and of the tropical countries especially. For many years the forests of some of these countries will have far greater economic significance as the sources of oils, gums, resins, tannin, and other materials than for their timber. So far, merely the surface has been scratched, and only a few species are being exploited on a commercial scale out of the hundreds that are capable of yielding valuable products. In many regions the commercial exploitation of the tropical woods will be feasible only if accompanied by the utilization of the secondary products.

In the following pages some of the more important of these materials are treated briefly, with the object of emphasizing the close relation between the forests and various industries. Knowledge of the kinds of raw materials required, on the one hand, and of the distribution of these materials throughout the world, on the other hand, provides a basis for forecasting the course which development of the industries will take in the future. For more detailed information regarding these resources the reader is referred to the material given under the individual countries.

PULP AND PAPER

Although a number of plants yield fiber suitable for making paper, trees are by far the most important, since between 80 and 90 per cent of the world's production of paper is made from wood fiber. Several

of the fairly soft woods of the broad-leafed species are used to a limited extent, but the spruces, firs, pines, and hemlock, together with their constant associate, aspen, are and for a long time will continue to be the principal woods used for pulp and paper production. It is only natural, therefore, that the production of pulp should develop almost exclusively in the coniferous forests of the temperate regions. There is close relation between abundance of coniferous timber and pulp production, provided other requisites such as labor and cheap motive power, especially water power, are available.

In Table 418 is shown the estimated amount of wood pulp which the existing mills of the different countries would have produced in 1919 if they had operated at their full capacity. The extent of their coniferous forests is also given.

Of this total, amounting to nearly 13,500,000 tons, about half was mechanical ground-wood pulp, and the other half comprised chemical

TABLE 418.—POSSIBLE MAXIMUM WOOD PULP PRODUCTION (1919)

Country	Area of coniferous forests	Total production of pulp
	million acres	*short tons*
Former Austria-Hungary	25.0	589,200
Belgium	0.4	60,500
Brazil	100.0	3,600
Canada	546.7	2,049,700
Denmark	0.4	2,400
Finland	43.2	374,000
France	4.9	250,000
Germany	20.7	1,880,000
England	0.8	74,000
Italy	0.6	68,200
Japan	21.3	49,600
Mexico	35.0	1,400
Newfoundland	6.0	151,800
Norway	12.8	924,800
Portugal	2.4	3,000
Rumania	6.2	2,500
Russia	1,158.4	295,000
Spain	10.5	6,000
Sweden	48.6	1,852,300
Switzerland	1.6	7,500
United States	340.0	4,702,600
All others	263.5	negligible
Total	2,649.0	13,348,100

pulps made by the soda, sulphite, and sulphate processes. Allowing 110 cubic feet of wood for a short ton of dry mechanical pulp and 240 cubic feet for a ton of dry chemical pulp, the wood pulp production in the world would consume annually about 2,300,000,000 cubic feet. The total amount of pulp actually made, however, is probably considerably less than the above estimate, for the United States produced only about 75 per cent of the figure given. If the consumption is three-fourths of the above quantity and the average annual growth in pulpwood forests is taken as 40 cubic feet per acre, which is a liberal assumption, 43,000,000 acres of well-managed forests is necessary to maintain the present requirement for pulpwood alone.

At present Sweden, Norway, and Finland are the chief exporters of pulp to neighboring countries of western Europe and to North America. Canada and Newfoundland, whose pulp industry is based almost exclusively upon spruce and fir, export a large part of their product to the United States and England. Although the United States is the largest single producer of pulp, its consumption of paper is so enormous that it depends on large importations from abroad, especially from Canada.

The relation of paper production to forest resources, of course, is not as close as that between production of wood pulp and available supplies of coniferous timber. Several countries, Great Britain, for instance, produce large quantities of paper made from imported pulp. The total world production of paper in 1907 was 7,760,133 metric tons;

TABLE 419.—WORLD PRODUCTION OF PAPER (IN METRIC TONS)

Country	1907	1913	1920
Germany	1,292,850	1,611,240	1,055,060
England	893,010	922,140	[1]
France	567,980	725,470	867,000
Austria-Hungary	371,163	427,914	156,460
Czechoslovakia	.....	.....	226,070
Sweden	232,500	319,302	229,227
Russia	235,530	338,340	32,800
Norway	119,000	198,400	[1]
Finland	77,000	224,950	162,459
United States	3,975,000	3,389,207	7,334,614
Canada	240,100	340,650	1,089,235
Other countries	756,000	1,192,803	[1]
Total	7,760,133	9,690,416	11,152,925

[1]Statistics not available. Total production including these countries was probably at least 13,000,000 tons.

in 1913, 9,690,416 tons, and in 1920, about 13,000,000 tons. Table 419 gives the production by countries.

Although the bulk of paper in the world today is made of wood pulp, many other materials are used, especially in the Mediterranean region, China, and Japan, and other tropical countries. Among them are esparto grass, produced in large quantities in the countries bordering the Mediterranean; paper mulberry (*Broussonetia papyrifera*), the bark of which is extensively used in the thousands of primitive paper-making establishments of China and Japan; bamboo, now employed on a small scale and capable of much more extensive utilization for paper; and many other fibres such as bagasse, rice straw, cotton rags, jute, and grasses.

The consumption of paper may be considered to some extent a criterion for the degree of culture a country has attained. Table 420 gives the per capita consumption of print paper in some of the different countries in 1910.

TABLE 420.—CONSUMPTION OF PRINT PAPER (1910)

Country	Per capita	Country	Per capita
Europe:	*lbs.*	Europe:	*lbs.*
Great Britain	54.6	Spain	8.4
Sweden	44.4	Portugal	6.8
Germany	44.2	Russia	5.1
Netherlands	38.1	Turkey	4.2
France	32.8	Greece	3.5
Switzerland	32.6	Bulgaria	3.3
Norway	31.5	Serbia	2.9
Finland	29.7	Rumania	2.6
Belgium	28.4	Bosnia	1.5
Denmark	25.3	Australia	36.1
Austria	24.0	North America:	
Italy	14.7	United States	57.4
Hungary	11.2	Canada	56.8
Luxemburg	10.6		

The tendency is for the consumption of paper and other products made from wood pulp to increase in all countries, even those which already use the largest amounts. The United States, for instance, increased its per capita consumption of wood pulp by approximately 40 per cent between 1910 and 1920. The demand for paper throughout the world, then, can be expected to increase almost indefinitely.

Large as the demand for wood pulp to meet the increasing needs

of the world for paper may be, there is no reason for alarm as to the possibility of meeting this requirement. Pulpwood, unlike large construction timber, does not require many years to mature. Much of the wood that may be cut in making thinnings in growing forests can be used for pulp, and since utilization of pulpwood is very close the use of the forest is most economical. Furthermore, as a result of the better fire protection which is coming about as the first step toward forestry in most of the countries, there are now large areas of young second growth which may be utilized for pulp. Some countries like Norway, Sweden, and lately even Finland, are gradually converting their forests from timber to pulpwood production.

The coniferous forests of the world still remain the chief potential sources of pulp and paper. With the constantly growing demand for paper and gradual exhaustion of the old supplies, it may be expected that the pulp industry will attain its further development in the northwestern portion of the United States, British Columbia, Alaska, northeastern Russia, and Siberia. An analysis of the extent of coniferous forests in the different countries given in Table 418 on page 958 will aid in forming an idea of the possibilities of the pulp industry in those countries.

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RESINS, GUM-RESINS, BALSAMS, AND TRUE GUMS

Forests are the principal source of resins, gums, and balsams, which are exuded from living trees or in some instances occur as fossil deposits. The principal distinction between true resins and gums is that resins are insoluble in water and more or less soluble in organic solvents, while of the gums the reverse is true. Gum-resins consist of a mixture of gum soluble in water and a considerable proportion of true resin. Balsams are oleoresinous exudations containing aromatic substances. These products

TABLE 421.— SOURCES OF PRINCIPAL RESINS AND GUMS

Commercial Resins

Trade name	Species from which derived	Region of occurrence	Character of the resin
Common or pine resin	*Pinus* species, principally those belonging to the "hard" or "yellow" pine group	Southeastern United States, Mexico, Central America, West Indies, southwestern France, Portugal, Spain, northern Africa, Balkan region, Germany, Austria, Baltic region, Russia, India, and Indo-China	Derived from living trees, or by distillation from stumps, knots, and logging waste. From it are obtained rosin and spirits of turpentine
West African copal	*Copaifera guibourtiana, Cyanothyrsus ogea,* and *Daniella oblonga*	West Africa, from Sierra Leone to Angola	Fossil, semi-fossil, and also derived from living trees. This and the other copals are used in varnish
East African copal	*Trachylobium verrucosum* and *T. mosambicense*	British and Portuguese East Africa	Fossil copal
Kauri copal	*Dammara australis* (*Agathis australis*)	Northern part of New Zealand and New Caledonia	Derived from living kauri pine, and also found in fossil state
South American copal	*Hymenaea courbaril* and other species of *Hymenaea*	South and Central America and West Indies	Derived from living trees
Dammar resin	*Hopea odorata, Shorea robusta, Balanocarpus* sp., and *Agathis lorantifolia*	Malay Peninsula, Sumatra, and other islands of the Dutch East Indies	Obtained from living trees. Used for varnish
Elemi resins	Species of *Canarium*, principally *Canarium luzonicum*	Philippine Islands	Somewhat soft, aromatic oleoresins
Shellac	The resin is secreted by the so-called lac insect, *Tachardia lacca.* The tree upon which it usually lives is *Butea frondosa*	British India. Another kind of shellac comes from Argentina	One of the most important resins of commerce
Mastic resin	*Pistacia lentiscus*	Mediterranean region; especially cultivated in Chios	Used to a certain extent in lithographic work and also for pale-colored spirit varnishes
Sandarac resin	*Callitris quadrivalvis* and *Callitris verrucosa*	Northwest Africa and Australia	Used principally for the preparation of spirit varnishes
Guaiacum resin, or gum guaiacum	*Guaiacum officinale* and *Guaiacum sanctum*	Tropical America	Derived from living trees. Medicinal
Dragon's blood, or Sanguis draconis	*Daemonorops draco*	Islands of the Indian Archipelago, principally Sumatra and Borneo	
Socotra dragon's blood	*Dracoena cinnabari*	Southeastern Asia, Socotra, and East Indies	
Acaroid resins	*Xanthorrhoea australis* and *X. hastilis*	Australia, Tasmania	Derived from living trees
Amber	*Pinites succinifer*	Collected near the Prussian Baltic Coast	Fossil resin
West Indian elemi	*Bursera gummifera*	West Indies, Central America, northern South America	Aromatic resin. Used in medicine

TABLE 421.—SOURCES OF PRINCIPAL RESINS AND GUMS—*Continued*

Gum-Resins

Trade name	Species from which derived	Region of occurrence	Character of the resin
Gamboge	*Garcinia morella*	Siam and Ceylon	Yellow, used in water-color painting
Asafoetida	*Ferula scorodosma*, *Ferula narthex*	Persia, Afghanistan	Hard gum, having strong odor resembling garlic
Myrrh and bdellium	*Balsamodendron* sp. and *Commiphora* sp.	India, Arabia, and Somaliland	

Balsam

Balsam of copaiba	*Copaifera langsdorfii*, *Copaifera officinalis*, and other species	South and Central America	Aromatic odor, acrid, nauseous taste
Balsam of tolu	*Myroxylon toluifera*	South and Central America	Aromatic exudation
Balsam of Peru	*Myroxylon pereirae* or *Myrospermum salvatorense*	El Salvador	Highly aromatic
Storax	*Liquidambar orientalis* and *Liquidambar styraciflua*	Southwestern portion of Asiatic Turkey, Southeastern United States, Mexico, Central America	Sweet aromatic odor
Canada balsam	*Abies balsamea*	United States and Canada	Oleoresinous exudation

True Gums

Rubber or caoutchouc	Many species of *Hevea*, *Castilloa*, *Maniñot*, *Ficus*, *Landolphia*, *Funtumia* and others	Tropical Africa and America, and extensively cultivated in the East Indies	
Gutta percha	*Palaquium gutta*	Malay Archipelago	
Balata	*Mimusops globosa* and other species	Tropical America, especially Guiana	Gum, intermediate in character between rubber and gutta percha
Chicle	*Achras sapota*	Mexico, Central and South America	Basis of chewing gum
Gum arabic	*Acacia senegal*	Sudan	Nearly odorless and has a mucilaginous and insipid taste
Australian or wattle gums	Several species of *Acacia*	Australia, also many acacias in South America and Africa yield gum	
Gum tragacanth	*Astragalus*, especially *Astragalus gummifer*	Turkey, Persia, and Afghanistan	Derived from living trees
Kino	*Pterocarpus* spp.	Southern India, tropical Africa, West Indies	Medicinal
Camphor	*Cinnamonum camphora*	Japan, Formosa, central China, and planted to some extent in other tropical countries	White, crystalline, having a characteristic odor
Spruce gum	*Picea* spp.	United States, Canada, Europe	Used for a chewing gum

are very numerous and have a wide variety of application in medicinal and industrial use. While some of them are produced in every forest region of the world, the greatest variety come from the tropical forests.

The most widely known commercial resins, gum-resins, balsams and gums, are listed in Table 421.

Naval Stores.—Spirits of turpentine and rosin, or, as they are called in the United States, naval stores, are derived from the resin obtained by chipping or wounding the sapwood of living coniferous trees, especially pine. Another process of obtaining turpentine, rosin, pine tar, and pitch is by distillation of the wood itself, either dead and resinous wood, especially stump wood and pitchy "pine knots," or chips of green wood. In general, the pines of the warm-temperate and tropical regions are the principal sources of turpentine and rosin. The pines of colder climates, although they yield a certain amount of resin, have a very short producing season and the yields obtained are not sufficient to make the process profitable on a large scale.

In the United States, where the bulk of naval stores is produced, the southern yellow pines, especially longleaf pine (*Pinus palustris*) and slash pine (*Pinus heterophylla* or *P. caribaea*), are best adapted for the production of turpentine and rosin, and from them comes by far the greatest proportion of the world's supply. Large forests of these pines now occur in the United States only in Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. Although North and South Carolina formerly produced most of the naval stores, their present output is very small; the peak of production has passed through Georgia and is now in Florida on its way to Louisiana and Texas. It has been determined by experimental turpentining that the western yellow pine which occurs extensively in Arizona, New Mexico, California, Oregon, and Idaho, will yield a good quality of turpentine and rosin. Because of the short producing season and the comparatively small yields, however, this species will probably not be used as long as sufficient longleaf pine is available.

France, Spain, and Portugal also have a species of pine (*Pinus maritima*) and a climate which makes large-scale production of turpentine and rosin a profitable undertaking. The industry in these countries, however, is probably as large as it can be considering the present extent of pine forests. Other countries, especially Mexico, Central America, the West Indies, and India, have produced small amounts of turpentine and rosin and contain bodies of timber which can support considerably expanded operations. Some of the northern countries, such as Russia and Sweden, have fairly large supplies of pitchy wood from which wood turpentine has been produced, but have manufactured very little rosin. During the war Germany succeeded in producing large quantities of turpentine and rosin from Scotch pine (*Pinus sylvestris*).

This industry will probably not be able to survive after Germany is able to import freely from other regions. In the Mediterranean region the pines from which naval stores are obtained are maritime pine (*Pinus maritima*), Aleppo pine (*P. halepensis*) and Austrian or black pine (*P. laricio*). In India chir pine (*P. longifolia*) yields resin.

The world's production of spirits of turpentine is about 45 million gallons, and of rosin about 5½ million barrels of 280 pounds gross weight each. Table 422 gives the production of turpentine and rosin by the principal producing countries.

TABLE 422.—PRODUCTION OF TURPENTINE AND ROSIN

Country	Turpentine	Rosin
	gallons	280 *lbs. gr. bbls.*
United States	31,860,000[1]	3,780,000[1]
France	6,400,000[2]	750,000[2]
Spain and Portugal	1,200,000[3]	140,000[3]
Russia	2,250,000[4]	.....
Mexico	150,000[5]	16,000[5]
India	100,000[6]	12,000[6]
Central America	5,000[7]	600[7]
Total	41,965,000	4,698,600

[1] Average U. S. Census figures, 1907–1910.
[2] *Bull. Roure Bertrand Fils*, 1909.
[3] *Chemist and Druggist*, 1907.
[4] Average exports, 1906–1910.
[5] Based on exports, 138,000 gals. to U. S. in 1911.
[6] Indian Forest *Bull.* 26, 1914.
[7] Based on exports of 4,500 gals. to U. S. in 1909.

In the United States, France, Spain, and Portugal the industry has been in operation for many years and may be considered as fully developed, so that there is not much chance for expansion. In Russia, Mexico, India, and Central America the industry is in its infancy, and there is a very good prospect of largely increased production. This is especially true of Russia, whose immense forests may yield great quantities of turpentine and rosin. India cannot produce more than 800,000 gallons of spirits of turpentine and about 56,000,000 pounds of rosin in a year. Spain, Portugal, Greece, and the countries of southeastern Europe will remain minor factors, and Algeria, Tunis, and Corsica are of little importance. Parana pine (*Araucaria brasiliana*) of Brazil is said to contain considerable resin, and may be utilized

for the production of naval stores. Chile has planted fairly extensive pine forests, and expects to produce enough turpentine partly to supply her own requirements.

The United States is now the leading country in the production of naval stores. Only one other country, France, can be considered a rival, and she produces only about one-quarter as much as the United States. The turpentine and rosin industry in France rests on a permanent basis, secured by careful handling of the maritime pine forests, which produce continuous crops of pine timber on a 60-year rotation, and are turpentined from 30 years of age up to the time of cutting. In the United States the industry rests on supplies of already grown timber, mostly from 100 to 200 years old, which are constantly dwindling as the longleaf pine is cut by the lumber industry, and no adequate provision is made for maintaining the supply of standing timber by securing new stands on the cut-over lands.

Turpentine orcharding in the United States covers annually ten times as much area of merchantable pine (about 10 million acres) as it does in France (about 1 million acres), but yields only five times as much turpentine and rosin. The average age of the French timber turpentined is considerably less than half of that turpentined in the United States. The pine forests of the southern United States, which are the present source of supply of turpentine and rosin, are being rapidly depleted by lumbering operations. Few of the large sawmills in the South have more than ten or fifteen years' supply of timber in sight, and after these large blocks of timber are exhausted there will necessarily be a serious reduction in the output of turpentine and rosin. In this country turpentining is becoming largely an adjunct to lumbering, and turpentining operations are carried on only for about three years previous to the cutting of the trees for lumber.

As the production of turpentine and rosin from living trees declines, there will probably be a large expansion in the production from the stumps and lightwood of the cut-over territory. The naval stores industry may thus be continued for some time after the destruction of the present forests, but total consumption of the stumps and dead wood will naturally follow within a few years.

In order to preserve the supply of pine timber for turpentining operations in the United States it will be necessary to set aside tracts for the practice of conservative methods, whereby the production of crude gum may be continued over a longer period of time even if smaller annual yields are obtained, and a cutting program must be arranged whereby opportunity is given for reforestation of the cut-over areas. It is estimated that to maintain the present annual production in the United States of turpentine and rosin by orcharding,

that is, by chipping and wounding live trees, it would be necessary to set aside for conservative management 20 million acres of longleaf pine land, averaging 2,000 to 3,000 feet per acre, or containing in all 40 to 60 billion feet of standing timber. This represents about one-third of the present estimated merchantable stand of longleaf pine. It is believed that with a reasonable amount of fire protection there would be an average annual growth of 50 board feet of longleaf pine per acre, or one billion feet on 20 million acres, which would provide also for an annual lumber cut, in perpetuity, of one billion board feet of turpentined timber. This is about one-tenth of the present annual lumber cut of longleaf pine.

Unless the turpentine industry is placed on a permanent basis, as it is in France, the leadership which the United States now holds will pass to France, which has long been watching the dissipation of the longleaf pine resources in the belief that eventually the field will be left largely to her.

The United States, France, Spain, and Portugal control practically the entire output of naval stores. The United States exports considerably more than half of the turpentine and rosin it produces, while France exports about half of its turpentine and two-thirds of its rosin. The Baltic countries produce their own turpentine and import most of their rosin. Mexico, India, and Central America, although producing both turpentine and rosin, do not yet produce enough for their own use. Great Britain, one of the largest consumers of naval stores, produces none, and Germany before the war depended entirely upon imports to satisfy her large requirements.

The world consumption is estimated at about 45 million gallons of spirits of turpentine and about 5½ million barrels (of 280 pounds) of rosin a year, and the requirements are growing steadily. To provide sufficient supplies, not only will it be necessary to develop all available forests of resinous pines, but other resiniferous species, of which there are a considerable number, must be fully exploited. Even this will not suffice in the long run, unless the forests are managed definitely with the idea of permanent, continuous production of naval stores along with the timber.

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RUBBER

Rubber is made from the coagulated milky juice of a large variety of plants, which grow almost exclusively in the tropics. Until about 20 years ago, it was entirely derived from native trees and vines of the tropical forests of South and Central America, East and West Africa, and Asia. Although the bulk of the world's production of crude rubber is now obtained from plantations, the native forests still are an important factor in the industry.

The principal rubber-producing species native to Asia is *Ficus elastica*, which grows from 100 to 165 feet in height in Bengal, Assam, Burma, and the islands of the Malay Archipelago. Yields from this species are very uncertain. The tree is cultivated to some extent but without marked success.

In Africa the most important rubber-producing plant is *Funtumia elastica*, a tree of the primeval forest which reaches 100 feet in height. It grows on the Ivory Coast, the Gold Coast, in the southern part of Nigeria, in Cameroon, French and Belgian Congo, Uganda, and eastward to the sources of the Nile, and southward to the Zambezi. It thrives best in moist, hot tropical climates, at altitudes between 300 and 1,300 feet. Depth and fertility of the soil are necessary to produce vigorous growth and high rubber content. The tree is ready for tapping in six or seven years, and the rubber is of medium quality. This species has been planted experimentally, without much success, on the island of Ceylon. Rubber is also obtained in Africa from various lianas of the *Landolphia* species, and from the roots of certain creeping plants and shrubs of the dry savanna region of the southern Congo basin.

The most abundant and valuable rubber plants are indigenous to tropical America. Para rubber, the finest grade, is a product of *Hevea* (*Siphonia*) *brasiliensis*. This tree, which reaches 65 to 130 feet in height, is distributed throughout the forests of the Amazon basin which are flooded during the rainy season, and in the region of the Orinoco river. *Hevea* belongs to the moist, hot tropical belt. It requires uniform

temperature, abundant rainfall, and high atmospheric moisture, and grows best at altitudes below 1,000 feet. The tree is ready for tapping in from 4 to 8 years after planting, in India, and in 15 years in plantations and 25 years in the wild state, in the Amazon region. With careful management a tree yields about 10 pounds of rubber annually. Other species producing rubber are *Castilloa elastica,* of Mexico, Central America, and South America, from which castilloa rubber is obtained; *Manihot glaziovii* and other *Manihot* species, chiefly in Brazil, which yield ceara rubber; *Hancornia speciosa,* of northeastern Brazil, from which Pernambuco rubber is obtained, and several others. These, however, are of secondary importance.

As a result of wasteful exploitation by the natives, the world output of this commodity was beginning to be scarce when the civilized countries of Europe began to plant rubber trees in their tropical colonial possessions. In southern Asia and the East Indies these plantations consist largely of *Hevea brasiliensis.* Plantations of rubber trees made in the Malay Peninsula within the last few years now yield more rubber than the entire world produced in 1911. Since rubber from planted *Hevea* is superior to all grades except native Para rubber, it will probably crowd from the market all lower grades of rubber, both native and planted, as the demand can with difficulty keep pace with the supply. Rubber production has also increased greatly in Ceylon, where the Para rubber tree has been cultivated since 1876. In 1912 more than 6.400 tons was exported, mostly to Great Britain and the United States, and it is expected that the annual output will eventually be 50,000 tons. There are large plantations of *Hevea* rubber in the Dutch East Indies; and Java, Sumatra, and Borneo are now second only to the Malay Peninsula in total yield. In Africa rubber production is based upon the exploitation of wild plants; hence it is likely to fall off to a great extent.

The production of rubber in South America is extensive. Most of it is now from natural forests, but some plantations have been made. Brazil, the principal producing country, exports its products chiefly to Great Britain and the United States. Previous to 1911 it supplied from one-half to two-thirds of all the rubber in the world, while now, although its output has not declined very greatly, it represents only about one-tenth of the world total. Bolivia, Peru, and to some extent Ecuador, Colombia, Venezuela, and the Guianas also export rubber. The production of Central America and Mexico is small. In Mexico rubber is obtained from *Castilloa elastica* and also from guayule, a low shrub of the northern deserts.

Table 423 summarizes the principal trees from which commercial rubber is derived.

TABLE 423.—PRINCIPAL SOURCES OF RUBBER

Trade name	Species	Region of occurrence
	Central and South America	
Para rubber	*Hevea*, principally *Hevea brasiliensis.*	Valleys of Amazon River and its tributaries; also valley of the Orinoco and in Guiana.
Ceara or Maniçoba rubber	Species of *Manihot*, chiefly *Manihot glaziovii.*	South America. Especially abundant in northeastern Brazil.
Ule rubber, or caucho	*Castilloa elastica*	Central America, and northwestern South America.
Mangabeira rubber	*Hancornia speciosa, and other Hancornia* spp.	Northeast of Brazil.
Colombian rubber	Species of *Sapium*	Colombia and Guiana.
	Asia	
Assam rubber	*Ficus elastica*	British India, Ceylon, and Malay Archipelago.
Jelutong rubber	Species of *Dyera* and *Alstonia.*	Borneo and Sumatra.
Tongking rubber	*Bleckrodea tonkinensis*	Tongking. (A large tree which yields excellent rubber.)
	Africa	
Lagos rubber	*Funtumia elastica* (*Kickxia africana*).	From Uganda to West Africa.
Vine rubber	Species of *Landolphia*	Tropical Africa, including Sudan, Congo, Mozambique, and Madagascar (from 16° north latitude to 23° south latitude).

The distribution of the different species of rubber and their abundance is shown on the accompanying map (Fig. 14), based on Peter Reintgen's map in "Die Geographie der Kautschukpflanzen."

The growth in production of crude rubber during the last 10 years has been remarkable, as may be seen from Table 424. It will be noted that these figures are slightly different from those given in the chapter on Brazil, being taken from a different source, yet they agree in the main.

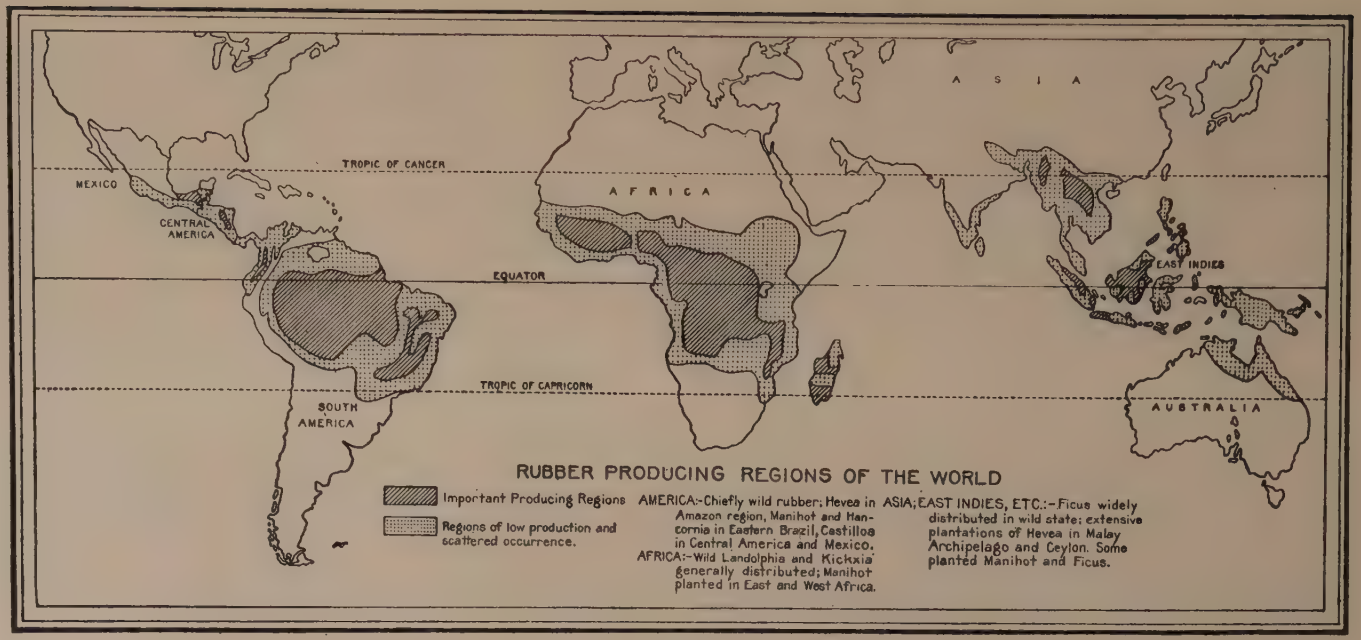
ASIA
TROPIC OF CANCER
MEXICO
CENTRAL AMERICA
AFRICA
EQUATOR
EAST INDIES
TROPIC OF CAPRICORN
SOUTH AMERICA
AUSTRALIA
RUBBER PRODUCING REGIONS OF THE WORLD
Important Producing Regions
Regions of low production and scattered occurrence.
AMERICA:-Chiefly wild rubber; Hevea in Amazon region, Manihot and Hancornia in Eastern Brazil, Castilloa in Central America and Mexico.
AFRICA:-Wild Landolphia and Kickxia generally distributed; Manihot planted in East and West Africa.
ASIA; EAST INDIES, ETC.:-Ficus widely distributed in wild state; extensive plantations of Hevea in Malay Archipelago and Ceylon. Some planted Manihot and Ficus.

FIG. 14.

Plantation rubber now constitutes about 90 per cent of the total world's production. The areas planted to rubber are shown in Table 425.

The largest area in rubber plantations is in the Malay Peninsula. With the shifting of the principal production from wild rubber to cultivated rubber, the region from which most of it is obtained has shifted also from South America to the East Indies. The British possess more than half of all the rubber plantations. Next to the British are the Dutch. The French and the Belgians are also extensive holders, and in recent years American rubber manufacturers have entered the field and own about 3 per cent of the total acreage.

In many of the tropical countries rubber constitutes the largest item of export trade, and in some cases forms almost the entire export.

Gutta-percha.—Gutta-percha is a product of several trees of southeast Asia, including *Palaquium gutta,* which yields the best grades,

TABLE 424.—WORLD'S PRODUCTION OF CRUDE RUBBER IN GROSS TONS

Year	Plantation rubber	Wild rubber		Total	Per cent plantation
		Brazil	Other		
1900	4	26,750	27,136	53,890	(1)
1901	5	30,300	24,545	54,850	(1)
1902	8	28,700	23,632	52,340	(1)
1903	21	31,100	24,829	55,950	(1)
1904	43	30,000	32,077	62,120	(1)
1905	145	35,000	27,000	66,145	(1)
1906	510	36,000	29,700	66,210	1
1907	1,000	38,000	30,000	69,000	1
1908	1,800	39,000	24,600	65,400	3
1909	3,600	42,000	24,000	69,600	5
1910	8,200	40,800	21,500	70,500	12
1911	14,419	37,730	23,000	75,149	19
1912	28,518	42,410	28,000	98,928	29
1913	47,618	39,370	21,452	108,440	44
1914	71,380	37,000	12,000	120,380	59
1915	107,867	37,220	13,615	158,702	68
1916	152,650	36,500	12,448	201,598	76
1917	213,070	39,370	13,258	265,698	80
1918	255,950	30,700	9,929	296,579	86
1919	285,225	34,285	7,350	326,860	87
1920	304,816	30,790	8,125	343,731	89

[1] Less than 1 per cent.

Palaquium longifolium, Palaquium borneense, Palaquium treubii, and *Payana leerii.* These trees grow only within the limited region from the southern part of the Malay Peninsula to Sumatra and Borneo. The trees are felled by the natives at the close of the rainy season for the purpose of obtaining gutta-percha. While tapping is unprofitable, experiments made in plantations in Java have shown that gutta-percha can be obtained from leaves and bark. Only tropical regions with high, uniform temperature and abundant rainfall are suitable for plantations of gutta-percha.

TABLE 425.—LOCATION AND AREA OF RUBBER PLANTATIONS ON JANUARY 1, 1920

Country	Planted		Producing	
	Acres	Per cent of total	Acres	Per cent of total
Malay Peninsula	1,750,000	53	1,250,000	46
Netherlands East Indies	885,000	27	570,000	25
Ceylon	398,000	12	267,000	12
South India	65,000	2	43,000	2
Borneo and Sarawak	50,000	1	30,000	1
Burma	45,000	1	17,500	1
Other countries	130,000	4	60,000	3
Total	3,323,000	100	2,237,500	100

Balata.—Balata, derived from the milky juice of the balata or bully-tree (*Mimusops globosa* and several other species of *Mimusops*) is very similar to rubber and is especially valued for making rubber belting. The tree occurs over most of northern South America and most of the West Indies, and is especially abundant in British Guiana. In that colony the collecting of balata gum is one of the principal industries. It was first exported about 60 years ago, and now the production is about 1,500,000 pounds a year in British Guiana, besides small amounts in neighboring countries. The average yield per tree is said to be about 5 pounds a year. A similar gum is obtained from *Mimusops elata* or massaranduba, which is abundant in the Amazon region and other parts of Brazil but is exploited more for its timber than for its gum.

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TANNING MATERIALS

Although a number of inorganic tanning substances are now being manufactured, such as chrome tannage and alum tannage, the production of leather still depends very largely upon the supplies of vegetable tanning materials. These are widely distributed in the plant world, and in the forests of practically all countries there are many species of trees which contain tannin in various quantities in the bark, wood, fruit, leaves, or roots. Only a few species which are particularly rich in tannin occur over a sufficiently large area to be ranked as important sources of vegetable tannin. The principal trees from which tannin in commercial quantities is now obtained are listed in Table 426.

Although the United States is the largest single producer of tanning materials, it is also the largest consumer. Hence its imports are greater than its exports. Chestnut wood and oak and hemlock bark are the principal domestic sources of tannin. Western hemlock, which is abundant in the Pacific Coast forests from Oregon to Alaska, may become an important source, although its bark has not yet been used to any extent for this purpose.

After the United States, the countries producing the largest amounts are France, Argentina, India, Turkey, Union of South Africa, Italy, Paraguay, Madagascar, Austria, Portuguese East Africa, Straits Settlements, Australia, Colombia, and Venezuela, in about the order given. In South Africa, India, and Australia, the United Kingdom controls very large sources of supply. France produces great quantities herself, besides controlling a large supply of mangrove bark and extract in Madagascar and other tropical regions.

The largest producer of tanning materials for export is Argentina, which sends immense quantities of quebracho wood and extract to many parts of the world. Paraguay also exports much quebracho. Wattle bark is exported principally from Australia and the Union of South Africa, and many species of acacia in tropical America are used locally for tanning but are not exported. Madagascar and Portuguese East Africa are the chief exporters of mangrove bark, while smaller quantities come from Venezuela and Colombia. Mangroves are used locally for tanning in Brazil, Central America, the West Indies, and the Philippines. A large part of the tanning material produced in Italy consists

of dried sumac leaves, and nut-galls and valonia constitute much of the Turkish production. While many materials are used in the small native tanneries of India, the only ones which are exported to a large extent are myrobalans, cutch, and gambier. The Straits Settlements and the Dutch East Indies also produce considerable quantities of gambier.

In South America and Mexico a number of materials are used locally for tanning, some of them in large quantities, and they are sufficiently abundant and of suitable quality to afford a basis for a large export trade in the future. The same is true of other species native to India, Australia, and other countries.

Table 427 gives the average pre-war exports and imports of tanning substances for the principal countries.

The United States and France are the only important industrial nations producing large proportions of their tanning materials, and only

TABLE 426.—PRINCIPAL SOURCES OF TANNIN

Common name	Botanical name	Region of occurrence
Quebracho	*Quebrachia lorentzii*	Argentina, Paraguay.
Hemlock	*Tsuga canadensis*	Eastern United States and Canada.
Chestnut oak	*Quercus prinus*	Eastern United States.
Tanbark oak	*Quercus densiflora*	California.
Other oaks	*Quercus* spp	Mexico.
Chestnut	*Castanea vesca*	Southwestern Europe.
	Castanea dentata	Eastern United States.
Mangrove or cutch	*Rhizophora mangle* and several other species	Shores of tropical and sub-tropical countries, especially Malay Archipelago, equatorial Africa, Madagascar, and northern South America.
Wattle bark	*Acacia* spp	Australia, Union of South Africa, South America.
Myrobalans	*Terminalia chebula*	British India.
Catechu	*Acacia* spp	British India.
Divi-divi or cascalote	*Caesalpinia coriaria*	Mexico, West Indies, northern South America.
Algarobilla	*Caesalpinia brevifolia*	South America.
Sumach	*Rhus coriaria*	Sicily.
Galls	*Quercus infectoria* and *Quercus lusitanica*.	Asia Minor and southeastern Europe.
Gambier	*Uncaria gambir*	Singapore and the Malay Archipelago.
Valonia	*Quercus aegilops*	Asia Minor.

a little more than half of the United States' consumption consists of domestic products. England, Germany, and Russia import practically all that they use. The tanning industry is becoming very important in Argentina, Brazil, and Mexico, all of which have abundant supplies of raw materials and will not need to import them.

TABLE 427.—EXPORTS AND IMPORTS, TANNING MATERIALS

Countries	Period	Imports	Exports
		long tons	*long tons*
Great Britain	1911–1913	98,518	30,637
France	1911–1913	22,127	18,704
Italy	1911–1913	28,757	52,451
Belgium	1911–1913	10,014	10,221
Portugal	1911–1913	.....	11
Russia	1911–1913	124,725	.....
Rumania	1911–1913	5,443	176
Serbia	1909–1911	602	.....
Japan and Formosa	1911–1913	2,959	294
China	1911–1913	6,790	11,761
Brazil	1911–1913	14	.....
United States	1912–1914	153,498	1,211[1]
Norway	1911–1913	573	.....
Sweden	1911–1913	8,396	1,042
Holland	1911–1913	9,015	3,725
Spain	1911–1913	357	.....
Switzerland	1911–1913	2,389	1,546
Mexico	1906–1910	.....	526
Argentina	1911–1913	.....	402,506
Chile	1911–1913	230	.....
Colombia	.....	.....	4,500[2]
Venezuela	1913	11	5,859
Denmark	1912–1913	5,594	.....
Germany	1911–1913	309,877	35,084
Austria-Hungary	1911–1913	43,683	63,474
Turkey	1910–1911	2,511	59,377
Bulgaria	1909–1911	1,392	2,453
Santo Domingo	1916	.....	600[2]
Union South Africa	.....	.....	55,000[2]
Portuguese East Africa	.....	.....	10,800[2]
Madagascar	.....	.....	21,900[2]
India	.....	.....	29,300[2]
Straits Settlements	.....	.....	6,100[2]
Australia	.....	.....	5,000[2]
Paraguay	.....	.....	23,000[2]

[1]Besides extracts valued at $522,000 (quantity not given).
[2]Approximately.

While the supplies in some regions may be becoming depleted, the forests of the world as a whole are capable of producing vastly greater quantities of tanning materials than are needed to meet the present requirements. Not only are there extensive supplies of mangroves, acacias, and other species included in the above list which have not yet been exploited, but there are hundreds of other species capable of yielding tannin on a commercial scale, the possibilities of which have been little investigated.

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DYEWOODS

The use of dyestuffs in general has increased enormously throughout the world in recent years. Although artificial coal-tar dyes have in large measure replaced natural dyes, some of the dyewoods are still exploited commercially. These woods contain coloring substances useful in dyeing fibers, textiles, feathers, wood, and leather. The principal commercial dyewoods and their occurrence, together with the color of the dyes that they yield, are given in Table 428.

Besides these, there are many other dye-yielding species in various tropical countries which are used locally or exported in small quantities. Some of these dyes are still preferred to synthetic dyes for special purposes. Logwood, for instance, is adapted particularly for coloring leather, and for some kinds of textiles it is considered superior to all artificial dyes. What was at one time an important industry in many tropical countries has since shrunk to comparatively small proportions. The West Indian and Central American logwood industry and the exportation of fustic are still factors in the world's commerce, but it is probable that coal-tar dyes will eventually replace vegetable dyes.

TABLE 428.—PRINCIPAL DYEWOODS

Common name	Botanical name	Region of occurrence	Color of the dye
Logwood, or campeche.	*Haematoxylon campechianum.*	West Indies and Central America, principally Haiti, Jamaica, Yucatan, and British Honduras.	Black and also shades of blue and violet. The extract of logwood is used extensively in the manufacture of ink.
Fustic, or mora....	*Chlorophora (Morus) tinctoria.*	West Indies, Central and South America. Mexico and Central America are at present the chief sources.	Yellow and brown.
Young fustic.....	*Cotinus (Rhus) cotinus..*	Chiefly in the dry regions about the Mediterranean.	Yellow.
Camwood.....	*Baphia nitida.....*	Tropical Africa, especially Sierra Leone. It is the only dye stuff used for dyeing cotton a mock turkey-red or barwood-red.	Red.
Barwood.....	*Pterocarpus santalinoides.*	Sierra Leone in West Africa.....	Red. It should not be confused with the wood of the related tree *Baphia nitida*, which sometimes is called barwood of commerce. The bulk of African dyes is produced by these two woods.
Red sandalwood...	*Pterocarpus santalinus..*	India.....	Red
Sappan.....	*Caesalpinia sappan....*	India, Burma, and adjacent countries.	Red. Largely used in calico printing.
Lima wood.....	*Caesalpinia crista.....*	Tropical America.....	Red.
Nicaragua wood...	*Caesalpinia brasiliensis.*	Tropical America.....	Red. Similar to that from Lima wood.
Pernambuco, Brazil wood, or peachwood.	*Caesalpinia echinata..*	Tropical America, especially eastern Brazil.	Red, orange, or peach.
Braziletto.....	*Caesalpinia bijuga.....*	Tropical America, chiefly Venezuela and Brazil.	Red.
Braziletto.....	*Haematoxylon brasiletto.*	Caribbean region.....	Red.
Redwood.....	*Caesalpinia tinctoria....*	Chile.....	Red
Redwood.....	*Adenanthera pavonina..*	India, Burma, Molucca, and North Queensland.	Red.
Onoto or annatto..	*Bixa orellana.....*	Tropical America.....	Red.
Drago, dragon's blood.	*Pterocarpus draco*, also *Croton* spp	Tropical America.....	Red.

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CORK

The cork of commerce is obtained from the bark of cork oak, of which two species are recognized, *Quercus suber* and *Quercus occidentalis*. These species are native to the western half of southern Europe and the coastal region of northwestern Africa. The total area under cork oak is about 3,763,800 acres (Table 429).

TABLE 429.—AREA UNDER CORK OAK

Country	Acres	Country	Acres
Algeria	1,052,220	Tunisia	247,000
Portugal	817,080	Italy	20,000
Spain	637,500		
Morocco	617,500		
France	372,500	Total	3,763,800

Algeria possesses the largest cork oak forests in the world. Those of Morocco cover a large area, but they have been ravaged for years by the inhabitants and have greatly deteriorated.

In Portugal the cork oak forests are distributed throughout the entire country. The trees are larger and grow more thickly in southern Portugal, while in the central and northern part of the country they are smaller or occur in stands mixed with other species.

In France the cork forests do not extend north of latitude 45°. They occur principally on the mountains and hills of lower Provence, the sandy plains of Gascony, the northern slopes of the Pyrenees in southeastern Languedoc, and the mountains of Corsica. Provence has the largest area, 284,000 acres, while Gascony has 60,250 acres, Languedoc 4,820 acres, and Corsica about 22,500 acres. The greater part of these forests, 290,290, acres, is private property, 55,242 acres belongs to municipalities, and 25,795 acres belongs to the state.

In Italy cork occupies about 20,000 acres. On the mainland it is confined to the evergreen forests of the coast, in Liguria, Tuscany, Roman Campagna, around the Gulf of Taranto, and on the plains of Euphemia. In Sicily it is found principally in the southeast and north, while in Sardinia it is widely distributed at medium altitudes throughout the island, often in mixture with other oaks.

In Spain the finest specimens of cork are found in regions of fairly abundant rainfall in the northeastern, southern, and southwestern provinces. Especially important are the cork forests of Catalonia (Province of Gerona), which produce a hard and rigid red bark of

exceptionally good quality. The cork of the Andalusian mountain regions (Provinces of Seville and Huelva) is white and porous, while that of Estremadura is dark.

The total production of cork amounts to about 232,500 metric tons, distributed among the different countries as shown in Table 430.

TABLE 430.—TOTAL PRODUCTION OF CORK

Country	Metric tons	Country	Metric tons
Spain	80,000	Italy	5,000
Portugal	80,000	Tunisia	4,000
Algeria	45,000	Corsica	1,000
Morocco	11,500		
France	6,000	Total	232,500

Spain, Portugal, and Algeria are the chief producers. Spain produces the most and the best cork in the world, and is the principal exporting country, with exports amounting to 46,000 tons in 1920. Cork forms a very important part of the export trade of Portugal. The raw material is worked up into slabs or other semi-manufactured products in Lisbon, Faro, Oporto, and other cities in Portugal, and in the provinces of Gerona and Seville in Spain. The principal Spanish ports of shipments are San Feliu de Guixols, Barcelona, and Palamos in the north, and Seville, Huelva, Cadiz, and Algeciras in the south. In Portugal nine-tenths of the exports go from Lisbon. Algerian cork is exported mostly through various ports of the Department of Constantine. The principal consumers of cork are the United States, Germany, the United Kingdom, and Russia, while almost all other countries use smaller amounts.

The production of cork has not yet reached its maximum. The cork oak forests of the world, as they gradually come under better management and care, are capable of producing much larger quantities, and there is no doubt that they will do so when the industries of the world require it.

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WOOD DISTILLATION

The wood distillation industry has two principal branches, distinguished by the kinds of wood used and by the resulting products.

The broadleafed species, upon being subjected to destructive distillation in kilns, retorts, or ovens yield charcoal, pyroligneous acid, and tar. On further distillation the acid and tar produce methyl alcohol and acetic acid, and in combination with lime the acetic acid produces acetate of lime. Methyl or wood alcohol has many industrial uses, chief among them being the manufacture of paints and varnishes. Acetic acid is employed largely by the paint, textile, and leather industries, while a great deal in the aggregate is used by smaller consumers such as laundries and manufacturers of drugs and inks. Acetone, a further product of acetate, is utilized for making explosives and chloroform. Charcoal is used largely in the northern countries in the manufacture of iron and steel, as well as for domestic uses. The use of charcoal for kindling, cooking, and domestic heating has increased rapidly enough to balance the decrease in consumption by the steel industry, which has been gradually substituting coke. In tropical countries charcoal is almost the universal domestic fuel. There it is made by crude methods, and the other products are wasted.

The average yield per cord (approximately 90 cubic feet) of the hardwoods commonly used in North America (birch, beech, and maple), when distilled in retorts or ovens is:

Charcoal	45 to 52 bushels (of 20 pounds each)
Gray acetate	180 to 225 pounds
Crude alcohol (82 per cent)	8 to 10 gallons

With kilns the yield of charcoal is about the same and of other products considerably less.

Before the war the United States produced from 70,000 to 82,000 short tons of acetate yearly, or about one-half of the world production. It made also approximately 400,000 short tons of charcoal and 13,500,000 gallons of crude and refined methyl alcohol. Austria-Hungary's production, chiefly from beech, was about two-thirds as great as that of the United States. Canada's output was about 60,000 tons of charcoal, 8,000 to 9,000 tons of acetate, and 1,500,000 gallons of alcohol, besides large quantities of acetic acid, acetone, formaldehyde, and other products. Hardwood distillation plants in the United States consumed from 1,200,000 to 1,500,000 cords of wood a year, representing approximately 140,000,000 to 175,000,000 cubic feet of standing timber.

The resinous woods of the conifers yield much smaller amounts of methyl alcohol and acetate than the hardwoods. Their most valuable

products are turpentine, tar, and oils. Destructive distillation of American yellow pine stump-wood yields on the average for one cord:

Refined turpentine	7 to 12 gallons
Oils, including tar oil	50 to 75 gallons
Tar	40 to 60 gallons
Charcoal	25 to 35 bushels

Steam distillation yields turpentine and oils, at the rate of 10 to 15 gallons of refined turpentine and 1 to 3 gallons of heavy oils per cord. The tar and oils obtained from softwood distillation are used for making wood preservatives, dryers, creosote, stains, and other products. This branch of the industry is most extensively developed in Russia, Finland, and Sweden, where Scotch pine (*Pinus sylvestris*) and Siberian larch (*Larix sibirica*) are the principal species used. In the United States southern yellow pine stumps and "light wood" constitute the principal raw material, with smaller amounts of Norway pine (*Pinus resinosa*) and Douglas fir.

Within the last few years processes have been developed for deriving ethyl alcohol from wood, by hydrolizing it with sulphuric acid. Ethyl alcohol has more uses than methyl alcohol, and is the most promising substitute for gasoline in internal combustion engines. Conifers yield considerably more than hardwoods, the averages being approximately 6 gallons per ton of wood for beech and elm, 9 for hard maple, 12 for white oak, and from 15 to 26 for pines, spruces, larch, hemlock, and Douglas fir. The great potentialities of this industry may be seen in the fact that the United States alone now uses something like 5 billion gallons of crude oil for the production of gasoline, equivalent in fuel value to about 7½ billion gallons of ethyl alcohol. It has been estimated that the wood waste in logging and milling, together with that wasted in the forest because it cannot be utilized at the right time, could yield almost 2½ billion gallons of alcohol.

The wood distillation industry has not yet secured a foothold in the tropics, although perhaps its best chance for future development is there. Tests made on a number of Brazilian woods, for instance, indicate that they can produce at least as much methyl alcohol and acetate per unit volume as the woods now used, while their charcoal residue weighs much more—in some cases twice as much as that of maple and beech. Moreover, many of them will yield various resins and other products which may have considerable industrial value. The establishment of distillation plants in connection with lumbering operations may make possible the commercial exploitation of tropical forests which cannot be developed profitably otherwise, since it will then be possible to utilize the large volume of defective and inferior material which cannot be

cut into lumber. In this connection it is important to bear in mind the extremely rapid rate at which trees grow in the moist tropical regions. The average growth under management is said to be at least five times that of the hardwood forests in the temperate zone. It is possible that as the supplies of mineral oil become depleted, the tropical forests may be called upon more and more to furnish the world with liquid fuel.

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EDIBLE PRODUCTS OF FORESTS

Many of the food products of trees are now grown as cultivated crops, and are of relatively little importance in the wild state. Such are most of the fleshy fruits—apples, pears, plums, peaches, cherries, citrus fruits, mangoes, figs, dates, bananas, and olives. Other products, although most of them are cultivated to some extent, still come largely from natural forests.

Chief among them are various nuts, the more important of which are listed in Table 431.

A great many other nuts not included in the above list are used locally for food purposes, but do not enter commerce to any extent.

The nuts produced in the greatest quantities are probably coconuts, chestnuts, walnuts, and Brazilnuts, and of these coconuts are far in the lead both in quantity and value.

The coconut palm (*Cocos nucifera*) is common throughout the tropical regions. Its home is not known, for it was distributed very widely in prehistoric times. Altogether, in Asia, Oceania and America, there are reported to be about 240,000,000 coconut trees, with a total yield capacity of 7 to 8 billion nuts a year. In the Philippine Islands alone in 1920 over 1.5 billion coconuts were gathered from 43,585,000 trees. Coconut palms are most abundant along the shores of the Indian

TABLE 431.—MOST IMPORTANT EDIBLE NUTS AND THEIR SOURCES

Trade name	Botanical name	Region of occurrence
Acorns	The acorns of numerous species of oak (*Quercus*) are edible.	Europe and North America, principally.
Brazil nut	*Bertholletia excelsa*	South America, principally the Amazon basin.
Bread nut	*Brosimum alicastrum*	West Indies.
Butternut	*Juglans cinerea*	Eastern United States.
Butter, pekea, or souari nut	*Caryocar* spp.	South America.
Cohune nut	*Attalea cohune*	Central America, South America.
Candle nut	*Aleurites triloba*	South Sea Islands.
Cashew nut	*Anacardium occidentale*	West Indies and tropical America.
Chestnut	*Castanea* spp.	Southern Europe, eastern United States, eastern Asia.
Coconut	*Cocos nucifera*	Tropics.
Dika nut	*Irvingia barteri*	West Africa.
Ginkgo nut	*Ginkgo biloba* (seed)	Japan, China.
Hickory nuts	*Hicoria* (*Carya*) *ovata*, *H. laciniosa*, and others.	Eastern United States.
Olive nut	*Elaeocarpus* spp	East Indies.
Pecan nut	*Hicoria pecan*	Southern United States.
Pine nut	*Pinus pinea*	Italy.
Piñon	*Pinus edulis* and other nut pines.	Southwestern United States.
Pistachio nut	*Pistacia vera*	Mediterranean region.
Shea butter	*Butyrospermum parkii*	Equatorial Africa.
Walnut	*Juglans* spp.	Asia, southern Europe, North America.

Ocean, from Ceylon eastward, and on all the islands of the Malay Archipelago. They also occur abundantly on both shores of Central America, all the islands of the West Indies, the north coast of South America, the South Sea Islands, and in equatorial Africa.

Chestnuts are grown in the greatest quantity in Italy, whose production in 1920 was 1,370,000,000 pounds. These are more in the nature of agricultural crops than forest by-products. In the United States, chestnuts have been collected mostly from the natural forests. The production has suffered a great decline since the invasion of the chestnut blight, and eventually will be of only minor importance..

Walnuts also are now for the most part grown in orchards. France, Italy, China, and Asiatic Turkey are the principal producing countries.

Brazilnuts still come almost entirely from the virgin forests of the lower Amazon basin. From 6,000 to 25,000 tons a year are exported,

depending on the crop. The production of these nuts could be greatly increased, as only the more accessible supplies are gathered now and the greater part goes to waste.

VEGETABLE OILS

African oil palm (*Elaeis guineensis*) is a very important source of oil which is used by the natives for food and medicine, and in Europe for making soap, butter substitutes, candles, and other products. The tree grows to a height of 35 to 50 feet and bears 800 to 1,500 fruits, the flesh and kernels of which contain oil in the proportion of from 20 to 40 per cent of their weight. The tree is a native of tropical Africa, and occurs singly and in stands from Senegambia to Angola and far into the Congo basin. It is also found on Lakes Victoria and Tanganyika, in smaller quantity on the coast of German East Africa, and also on the islands of Zanzibar and Pemba. It is extensively cultivated by the white population of the coast region of Upper Guinea, which is the chief producing region. The largest amount comes from the British colonies, and the production of the French colonies is also fairly large. Cameroon has many oil palms, but is rather isolated, while Togoland suffers from droughts which injure the trees. This species has recently been introduced into North Borneo, the Malay Peninsula, New Guinea, and Brazil, but is of little commercial importance outside of Africa. A related species, "coco de aceite" (*Elaeis* sp.) and cohune palm (*Attalea cohune*), both native of Mexico and Central America, produce considerable oil.

A number of the nuts listed above are chiefly valuable for their oil, many kinds of which besides their value for food are also useful in industry. The vegetable oil resources of the tropics have hardly begun to be exploited, and knowledge of their possibilities is yet very incomplete. It is certain that they will be a factor of constantly increasing importance in the commerce of the world.

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FACTORS USED IN CONVERTING VARIOUS WEIGHTS AND MEASURES

The following equivalents were used in most cases, except where otherwise noted, in converting quantities into American units:

Linear Measure

1 meter = 3.28 feet
1 centimeter = 0.3937 inches
1 arshine = 28 inches
1 sajen = 7 feet
1 verst = 3500 feet

Areas

1 square meter = 10.76 square feet
1 hectare = 2.47 acres
1 square kilometer = 247 acres
1 dessiatine = 2.7 acres
1 cho = 2.45 acres
1 ko = 2.8 acres
1 square mile = 640 acres

Volume

1 cubic meter = 35.3 cubic feet
1 stere = 23.3 cubic feet (solid)
1 load (capacity ton) = 40 cubic feet of round timber, or
50 cubic feet of squared timber
1 St. Petersburg standard = 120 cubic feet of round timber
150 cubic feet of hewn timber
165 cubic feet of sawed lumber
1 normal cubic sajen = 220 cubic feet (solid)
1 thousand board feet (lumber) = 219 cubic feet of standing timber

Weight

1 kilogram = 2.2046 pounds
1 metric quintal = 1 double centner = 220.46 pounds
1 metric ton = 2204.6 pounds
1 short ton = 2,000 pounds
1 long ton = 2,240 pounds
1 batman = 6.61 pounds
1 kin = 1.325 pounds
1 picul = 133.27 pounds
1 ton round timber = 56.48 cubic feet (Europe)
1 ton hewn timber = 70.60 cubic feet (Europe)
1 ton sawed lumber = 95.31 cubic feet (Europe)
1 ton charcoal = 275 cubic feet of timber
1 ton ground wood pulp = 123.5 cubic feet of timber
1 ton chemical pulp = 264.75 cubic feet of timber
1 ton paper = 176.5 cubic feet of timber
100 tons newsprint paper = 150 cords of wood
77 tons of wood pulp (unclassified) = 100 cords of wood

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All conversions made on par basis

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